ML521A/B
ML522A/B/C
ML524A/B/C
Measuring Receiver
Operation Manual

Fifth Edition

Measuring Instruments Division
Measurement Group

ANRITSU CORPORATION

MAR.
1995

M-W0282AE-5.0
(M-W0283AE-5.0)
(M-W0285AE-5.0)

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ML521A/B, ML522A/B/C, ML524A/B/C Measuring Receiver

Operation Manual

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Printed in Japan

Ni-Cd

WARNING

- To US Customers -

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of it's useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

Before disposing of this product, discharge the battery, and then mail the battery to your local recycling center.

1. Disconnect the ac adapter, if used.
2. Turn the power switch to on.
3. Leave the product on until the power indicator goes off; the battery is now discharged.
4. Remove the battery.
5. Insulate the battery terminals with adhesive tape.
6. Mail it to your local recycling center, or to the following address.

ANRITSU WILTRON SALES COMPANY
685 Jarvis Drive, Morgan Hill, CA 95037, USA

WARNING

NO OPERATOR SERVICEABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

ベルトをご使用になる場合

図１に示すようにプロテクタを本体に取付けてください。
次に図２に示すようにベルトを通して使用してください。

When Using Belt

Install the supplied protectors with the screws as shown in Figure 1.
Then, thread the belt as shown in Figure 2.

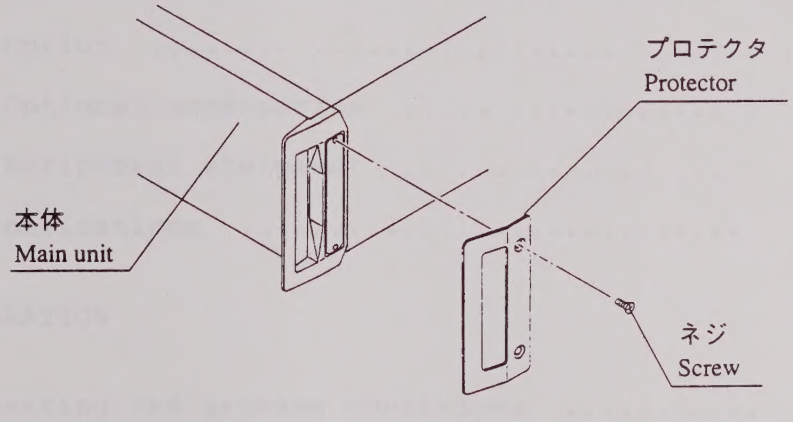

図１
Fig. 1

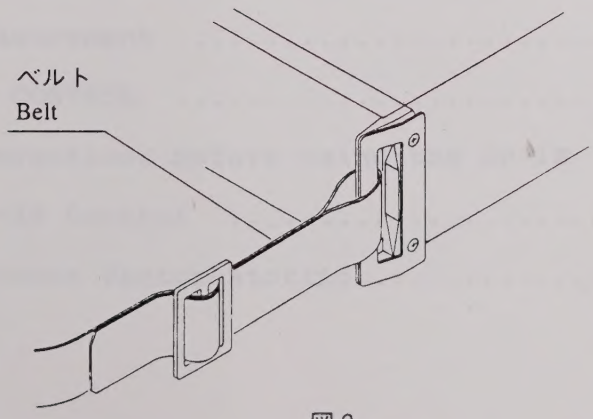

図２
Fig. 2

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SECTION 1

GENERAL

The ML521A/B, ML522A/B/C and ML524A/B/C Measuring Receivers are a miniaturized measuring receiver capable of measuring the voltage level with high resolution of 0.1 dB over a wide frequency range of 25 to 1000 MHz, and also performing remote control. The ML521A/B, the ML522A/B/C and ML524A/B/C can be used not only as a field strength meter in conjunction with a measuring antenna, but also as a general-purpose measuring receiver. For example, as a component unit of various radio equipment such as radio measuring equipment, radiowave monitoring equipment, radio applied industry instrumentation measuring equipment, etc.

The differences between types A, B and C of the ML521/ ML522/ML524 are as shown in Table 1-1.

Table 1-1 Differences Between Types A, B and C of the ML521/ML522/ML524

	Frequency range (MHz)	Frequency resolution (kHz)	Pass-band width (kHz)
ML521A	25 to 300	12.5	120
ML521B	25 to 300	1, 12.5	15, 120
ML522A	300 to 999.9875	12.5	120
ML522B	300 to 999.999	1, 12.5	15, 120
ML522C	300 to 999.9875	12.5	8, 15
ML524A	25 to 999.9875	12.5	120
ML524B	25 to 999.9999	1, 12.5	15, 120
ML524C	25 to 999.9875	12.5	8, 15

<Features>

Compact, light weight	:	210W x 60H x 175D mm, 3 kg (including built-in battery) ML524 is 255D mm and 4 kg
Wide frequency range	:	25 to 300 MHz (ML521) 300 to 1000 MHz (ML522) 25 to 1000 MHz (ML524)
High frequency stability	:	Reference frequency stability $\pm 1 \times 10^{-6}$
High precision frequency setting	:	1 kHz step [B type]
Wide dynamic range	:	80 dB
Built-in frequency memory	:	100 waves

Direct field strength reading (when used in conjunction with a specified antenna)

Externally controllable by IEEE-488 (GP-IB) : Option 01

<Applications>

(1) Micro-voltage measurement

- o Level detection of RF bridge, impedance meter, etc.
- o Level measurements on coaxial line used for production line, CATV, etc.

(2) Field strength measurement

- o The propagation test and service area measurement of mobile radio
- o TV/FM broadcast service area measurement, troubleshooting of radio interference

- o Checking of field strength from minipower stations such as wireless microphones, telecontroller, etc.
- o Measurement of the directivity and gain of antenna
- o Measurement of undesired radiation from radio applied equipment
- o Measurement of shielding effect of shielded room, shielding material, etc.

(3) Monitor receiver

- o Receives AM or FM wave for the radio monitoring

(4) Signal demodulator

- o Radio monitor: Monitors the signal by using the demodulated signal
- o Radio control: Controls equipment by using the demodulated signal

(5) Automatic systems

- o Automating of function operation for each item described in paragraphs (1) through (4) by using personal computer through GP-IB interface.

SECTION 2

COMPOSITION AND SPECIFICATIONS

This section describes the standard composition and specifications of the measuring receivers and the composition of option, optional accessories, and peripheral equipment for expanding their functions.

2.1 Composition

2.1.1 Standard Composition

The standard composition is shown in Table 2-1.

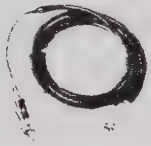
Table 2-1 Standard Composition

Item	Name	Qty	Remarks
Instrument	ML521A, ML521B, ML522A, ML522B, ML522C, ML524A, ML524B, or ML524C Measuring Receiver	1	
Accessories	Earphone	1	
	Recorder Connection Cord	1	With 3.5 ϕ plug, alligator clips, approx. 1.5 m long
	DC Power Cord	1	RM12BPG-5S-2CC7, with spade lugs, 1.5 m
	MZ110A Battery Pack	1	(Alkaline Dry Cell (LR14) x 6) Attached to ML521/ML522
	MZ114A AC Power Pack	1	Attached to ML524
	Carrying Bag	1	
	Protector	2	
	Operation Manual	1	
	Service Manual	1	

Earphone

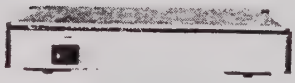
Recorder Connection Cord

DC Power Cord



MZ110A Battery Pack (for ML521, ML522)

MZ114A AC Power Pack (for ML524)



Carrying Bag

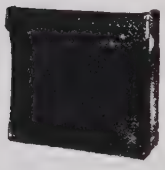


Fig. 2-1 Accessories

2.1.2 Option

The option available is shown in Table 2-2. The option must be purchased separately from the measuring receiver. Since the optional parts can be built in, the actual dimensions remain unchanged except for the connectors.

Table 2-2 Option

Option 01	GP-IB interface
	SH1, AH1, T1, L2, TE0, LE0, SR0, RL2, PP0, DC0, DT0, C0
	Listener function : Frequency, level, level calibration, level unit, attenuator
	Talker function : Frequency, level
	Talker only function : Frequency, level
	Note: The external dc power supply (12 V, 1.3 A) or MZ114A AC Power Supply should be used.

2.1.3 Optional accessories

Optional accessories are shown in Table 2-3 (1) and (2). As shown in Table 2-3 (1), this measuring receiver can select and use any power supplies for operation.

External view of the optional accessories are shown in Fig. 2-2 and Appendix A.

Table 2-3 (1) Optional Accessories
(power supply selection guide)

Type of power supply	Model & name	ML521/ML522	ML524	Remarks
Dry cell	MZ110A Battery Pack	o Continuous operation of approx. 20 to 40 minutes is available.* o Standard accessories.	———	o Six alkaline dry cells (LR14) are used. o Built in the instrument. o Unavailable for GP-IB.
Ni-Cd Battery	MZ110B Battery Pack	o Continuous operation of approx. 45 to 90 minutes is available.* o Sold separately	o Continuous operation of approx. 30 to 60 minutes is available.* o Sold separately	o Six Ni-Cd batteries are used. o Can be recharged 200 to 300 times. o Built in the instrument. o Unavailable for GP-IB
Dry cell	MZ137A Battery Pack	o Continuous operation of approx. 4 to 8 hours is available.* o Sold separately.	o Continuous operation of approx. 2.5 to 5 hours is available.* o Sold separately.	o Twelve alkaline dry cells (LR20) are used. o Unavailable for GP-IB

Table 2-3 (1) Optional Accessories
(power supply selection guide) (Cont'd)

Type of power supply	Model & name	ML521/ML522	ML524	Remarks
Sealed lead storage battery	MZ88A DC Power Supply	o **Continuous operation of approx. 5 to 10 hours is available.***	o **Continuous operation of approx. 3.5 to 7 hours is available.***	o 12 V, 7.5 AH
				o Built-in battery charger.
		o Sold separately	o Sold separately.	o Used to provide power to EXT +12 V terminal.
				o Available for GP-IB.
Ac power supply	MZ114A AC Power Pack	o Operation at 100 Vac or 220 Vac is available.	o Operation at 100 Vac or 220 Vac is available.	o Used to provide power to EXT +12 V terminal.
		o Sold separately	o Standard accessories.	o Available for GP-IB.
External power supply	—	o Used to provide external Dc power (Dc +12 V) to EXT +12 V terminal.	o Same as ML521/ML522	o Dc power cord accessory to the instrument is used.
Battery charger	MZ115A Battery Charger	o Sold separately	o Sold separately	o Capable of charging two MZ110B battery packs simultaneously.

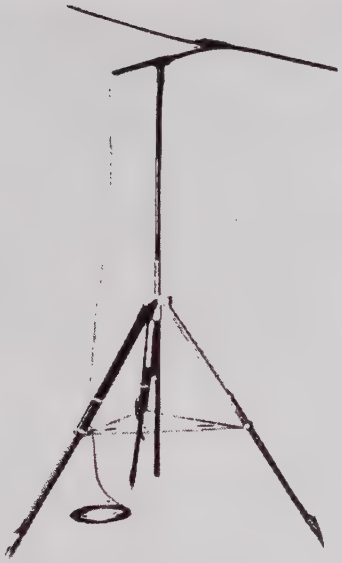
* For continuous reception after power on, with calibration performed once only (more calibrations reduce the operating time). Operating time is also affected by how the battery has been stored, and by operating temperature.

Headphone

Antenna

Headphone

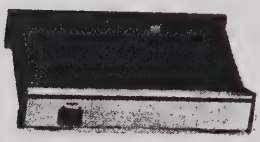
Dipole Antenna
MP534B



Log-Periodic Antenna
MP635A

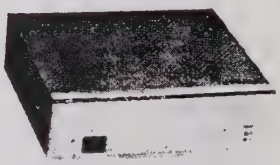
MZ110B Battery Pack

MZ114A
AC Power Supply



MZ137A Battery Pack

MZ115A Battery Charger



(Needs MZ110B)

MZ88A DC Power Supply
Built-in Lead Storage Battery

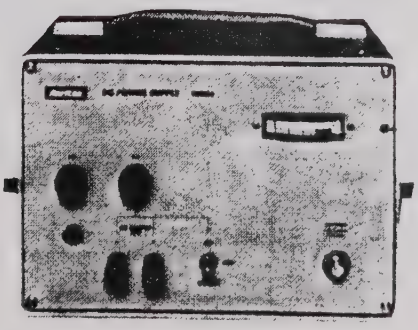


Fig. 2-2 Optional Accessories

Table 2-3 (2) Optional Accessories

Name	Description	Remarks
Headphone	Voice monitor	
Branch MP640A	This is used for branching a part of the transmitted signal. The output of the branch is attenuated approx. 40 dB.	For detailed information, refer to Appendix A (1)
CM Directional Coupler MP520A/B/C/D	This is used for measuring the passing power and spurious power.	For detailed information, refer to Appendix A (2)
High-Pass Filter MP526A/B/C/D/G	This is used for eliminating the fundamental signal and for measuring spurious.	For detailed information, refer to Appendix A (3)
T-Pad Z-164A/B 50 Ω, 75 Ω	This is used for measuring two-signal characteristics.	For detailed information, refer to Appendix A (4)
GP-IB cable	For connecting the GP-IB devices	1 m, 2 m, 4 m
Dipole Antenna: 25 to 1000 (1700) MHz The most standard, easy-to-handle antenna. (Gain: Approximately 0 dB).	MP534B Dipole Antenna (25 to 520 MHz) MP651B (470 to 1000 (1700) MHz) MB9A Tripod	
Log-periodic Antenna: 80 to 1000 MHz 200 to 1000 (2000) MHz The impedance characteristic and gain are almost flat over all frequency bands. (Gain: Approximately 5 dB).	MP635A Log-Periodic Antenna (80 to 1000 MHz) MB19A Tripod MP666A Log-Periodic Antenna (200 to 1000 (2000) MHz)	

2.1.4 Peripheral equipment

Peripheral equipment are explained in Table 2-4.

Table 2-4 Peripheral Equipment

Name	Application	Remarks
Personal Computer Packet IIe/III/ IIIs	Used as a controller for GP-IB remote control of the measuring receiver	For detailed information, refer to Appendix B
MH055B GP-IB Extender	For converting the GP-IB interface to serial interface	For detailed information, refer to Appendix C

2.2 Specifications

Specifications for the Measuring Receivers are shown in Table 2-5 below:

Table 2-5 Measuring Receiver Specifications

Model			ML524A	ML524B	ML524C
RF input			Nominal impedance 50 Ω, N-type connector		
Frequency	Range		25.000 to 999.9875 MHz	25.000 to 999.999 MHz	25.000 to 999.9875 MHz
	Display		Liquid crystal display 6 digits Minimum digit 1 kHz (0.5 kHz is displayed using a symbol of ■)		
	Resolution	120 kHz bandwidth *	12.5 kHz	1.25 kHz	—
		15 kHz bandwidth *	—	1 kHz	12.5 kHz
		8 kHz bandwidth *	—	—	12.5 kHz
	Setting		Keyboard and FINE dial		
	Memory		Up to 100 frequencies can be stored and recalled		
	Reference frequency stability		$\pm 1 \times 10^{-6}$		
Voltage measurement (E.M.F.)****	Minimum value	25 to 300 MHz	14 dBμV	5 dBμV	5 dBμV
		300 to 999.999 MHz	14 dBμV	5 dBμV	2 dBμV
	Maximum value	25 to 999.999 MHz	100 dBμV		
	Setting	C/N	≧6 dB (at minimum value)		
		Bandwidth*	120 kHz	15 kHz	8 kHz
	Accuracy (digital display)		±2 dB (≧minimum value +6 dB)**		
	Comparison oscillator		Pulse generator		
Field strength measurement	Minimum value	25 to 300 MHz	4 to 28 dBμV/m	−5 to 19 dBμV/m	−5 to 19 dBμV/m
		300 to 999.999 MHz	28 to 41 dBμV/m	19 to 32 dBμV/m	16 to 29 dBμV/m
	Maximum value	25 to 300 MHz	90 to 114 dBμV/m		
		300 to 999.999 MHz	114 to 120 dBμV/m		
	Setting	C/N	≧6 dB (at minimum value)		
		Bandwidth*	120 kHz	15 kHz	8 kHz
	Type of antenna		Half-wave dipole		

Table 2-5 Measuring Receiver Specifications (Cont'd)

Model			ML524A	ML524B	ML524C
Selectivity	6 dB bandwidth	8 kHz bandwidth	—	—	8 ±1 kHz
		15 kHz bandwidth	—	15 ±2 kHz	15 ±2 kHz
		120 kHz bandwidth	120 ±20 kHz	120 ±20 kHz	—
	Detuning characteristics	8 kHz bandwidth	—	—	≧45 dB (±12.5 kHz off center)
		15 kHz bandwidth	—	≧50 dB (±20 kHz off center)	≧50 dB (±20 kHz off center)
Image ratio			≧60 dB (at 25.000 to 299.999 MHz), ≧45 dB (at 300 to 999.999 MHz)		
Residual spurious			≦10 dBμV (typical near 50, 130, 600, 1000 MHz)		
Detection system			Average value		
Measured level indication	Display		Liquid crystal display 4 digits, minimum digit 0.1 dB (on digital display). Up to 80 dB (on analog meter)		
	Unit		dBμV, dBμV/m (on digital display)		
Monitor output			AM and FM can be heard from a loudspeaker, and earphone output terminal is also provided		
IF output	Level		≧85 dBμV at 80 dBμV input		
	Impedance		50 Ω (nominal)		
	Connector		BNC-type		
Discriminator output	Level		1 V ±20% (modulation frequency 2 kHz, frequency deviation 3.5 kHz, into 100 kΩ load)		
	Impedance		≦150 Ω		
	Connector		BNC-type		
Output for recorder	Level		1 V ±10% (at 80 dB on digital display, into 100 kΩ load)		
	Impedance		≦150 Ω		
	Connector		3.5φ jack		
Ambient temperature	Rated range of use		0° to 50°C		
	Rated range for storing		−20° to 60°C		
Power			DC 12 V: <1 A AC *** V, 50/60 Hz ≦35 VA (using MZ114A AC Power Pack supplied) Ni-Cd Battery (optional MZ110B Battery Pack)		
Dimensions and weight			60H × 210W × 255D mm, <4 kg		

Table 2-5 Measuring Receiver Specifications (Cont'd)

Model			ML522A	ML522B	ML522C
RF input			Nominal impedance 50 Ω, N-type connector		
Frequency	Range		300.000 to 999.9875 MHz	300.000 to 999.999 MHz	300.000 to 999.9875 MHz
	Display		Liquid crystal display 6 digits. Minimum digit 1 kHz (0.5 kHz is displayed using a symbol of ■)		
	Resolution	120 kHz bandwidth*	12.5 kHz	12.5 kHz	—
		15 kHz bandwidth*	—	1 kHz	12.5 kHz
		8 kHz bandwidth*	—	—	12.5 kHz
	Setting		Keyboard and FINE dial		
	Memory		Up to 100 frequencies can be stored and recalled		
	Reference frequency stability		$\pm 1 \times 10^{-6}$		
Voltage measurement (E.M.F.)	Minimum value		14 dBμV	5 dBμV	2 dBμV
	Maximum value		100 dBμV		
	Setting	C/N	≧6 dB (at minimum value)		
		Bandwidth*	120 kHz	15 kHz	8 kHz
	Accuracy (digital display)		±2 dB (≧ minimum value +6 dB)**		
	Comparison oscillator		Pulse generator		
Field strength measurement	Minimum value		28 to 41 dBμV/m	19 to 32 dBμV/m	16 to 29 dBμV/m
	Maximum value		114 to 120 dBμV/m		
	Setting	C/N	≧6 dB (at minimum value)		
		Bandwidth*	120 kHz	15 kHz	8 kHz
	Type of antenna		Half-wave dipole		
Selectivity	6 dB bandwidth	8 kHz bandwidth	—	—	8 ±1 kHz
		15 kHz bandwidth	—	15 ±2 kHz	15 ±2 kHz
	Detuning characteristics	4 kHz bandwidth	—	—	—
		8 kHz bandwidth	—	—	≧45 dB (±12.5 kHz off center)
		15 kHz bandwidth	—	≧50 dB (±20 kHz off center	≧50 dB (±20 kHz off center)

Table 2-5 Measuring Receiver Specifications (Cont'd)

Model		ML522A	ML522B	ML522C
Image ratio		≧45 dB		
Residual spurious		≦10 dBμV (typical near 50, 130, 600, 1000 MHz)		
Detection system		Average value		
Measured level indication	Display	Liquid crystal display 4 digits, Minimum digit 0.1 dB (on digital display) Up to 80 dB (on analog meter)		
	Unit	dBμV, dBμV/m (on digital display)		
Monitor output		AM and FM can be heard from a loudspeaker, and earphone output terminal is also provided.		
IF output	Level	≧85 dBμV at 80 dBμV input		
	Impedance	50 Ω (nominal)		
	Connector	BNC-type		
Discriminator output	Level	1 V ±20% (modulation frequency 2 kHz, frequency deviation 3.5 kHz, into 100 kΩ load)		
	Impedance	≦150 Ω		
	Connector	BNC-type		
Output for recorder	Level	1 V ±10% (at 80 dB on digital display, into 100 kΩ load)		
	Impedance	≦150 Ω		
	Connector	3.5φ jack		
Ambient temperature	Rated range of use	0° to 50°C		
	Rated range for storing	−20° to +60°C		
Power		DC 12 V: <700 mA AC *** V, 50/60 Hz ≦26 VA (using MZ114A AC Power Pack) R14 (SUM-2) Dry Battery (MZ110A Battery Pack) Ni-Cd Battery (MZ110B Battery Pack)		
Dimensions and weight		60H × 210W × 175D mm, <3 kg (including MZ110A)		

Table 2-5 Measuring Receiver Specifications (Cont'd)

Model			ML521A	ML521B
RF input			Nominal impedance 50 Ω, N-type connector	
Frequency	Range		25.000 to 300.000 MHz	
	Display		Liquid crystal display 6 digits. Minimum digit 1 kHz (0.5 kHz is displayed using a symbol of ■)	
	Resolution	120 kHz bandwidth*	12.5 kHz	
		15 kHz bandwidth*	—	1 kHz
	Setting		Keyboard and FINE dial	
	Memory		Up to 100 frequencies can be stored and recalled	
	Reference frequency stability		$\pm 1 \times 10^{-6}$	
Voltage measurement (E.M.F.)	Minimum value		14 dBμV	5 dBμV
	Maximum value		100 dBμV	
	Setting	C/N	≧6 dB (at minimum value)	
		Bandwidth*	120 kHz	15 kHz
	Accuracy (digital display)		±2 dB (≧ minimum value +6 dB)**	
	Comparison oscillator		Pulse generator	
Field strength measurement	Minimum value		4 to 28 dBμV/m	−5 to 19 dBμV/m
	Maximum value		90 to 114 dBμV/m	
	Setting	C/N	≧6 dB (at minimum value)	
		Bandwidth*	120 kHz	15 kHz
	Type of antenna		Half-wave dipole	
Selectivity	6 dB bandwidth	15 kHz bandwidth	—	15 ±2 kHz
		120 kHz bandwidth	120 ±20 kHz	
	Detuning character-istics	15 kHz bandwidth	—	≧50 dB (±20 kHz off center)
Image ratio			≧60 dB	
Residual spurious			≦10 dBμV (typical near 50, 130 MHz)	
Detection system			Average value	
Measured level indication	Display		Liquid crystal display 4 digits, Minimum digit 0.1 dB (on digital display) Up to 80 dB (on analog meter)	
	Unit		dBμV, dBμV/m (on digital display)	

Table 2-5 Measuring Receiver Specifications (Cont'd)

Model		ML521A	ML521B
Monitor output		AM and FM can be heard from a loudspeaker, and earphone output terminal is also provided	
IF output	Level	≧85 dBμV at 80 dBμV input	
	Impedance	50 Ω (nominal)	
	Connector	BNC-type	
Discriminator output	Level	1 V ±20% (modulation frequency 2 kHz, frequency deviation 3.5 kHz, into 100 kΩ load)	
	Impedance	≦150 Ω	
	Connector	BNC-type	
Output for recorder	Level	1 V ±10% (at 80 dB on digital display, into 100 kΩ load)	
	Impedance	≦150 Ω	
	Connector	3.5φ jack	
Ambient temperature	Rated range of use	0° to 50°C	
	Rated range for storing	−20° to +60°C	
Power		DC 12 V: <700 mA, AC *** V: 50/60 Hz, ≦26 VA (using MZ114A AC Power Pack) R14 (SUM-2) Dry Battery (MZ110A Battery Pack), Ni-Cd Battery (MZ110B Battery Pack)	
Dimensions and weight		60H × 210W × 175D mm, <3 kg (including MZ110A)	

* : 6dB bandwidth

** : Is guaranteed when Input Voltage is in the range of 6dB or more higher than each the minimum Measurement Range.

*** : Specify on nominal line voltage between 100V and 250V when the ordering.

****: emf (Electromotive Force)

SECTION 3

OPERATION

Paragraph 3.2 describes the operation common to both manual and GP-IB controlled operations.

The related matters for manual operation are described in paragraph 3.3, while the related matters for GP-IB control in paragraphs 3.4.1 and 3.4.2.

3.1 Operating and storage conditions

This instrument is designed to operate normally in an ambient temperature range of 0° to 50°C. For best operation, however, it should be used at normal room temperature whenever possible. Do not use or store the instrument in locations;

1. where vibrations are severe
2. where it is damp or dusty
3. where there is exposure to direct sunlight
4. where there is exposure to active gases
5. where there is exposure to magnetism
6. where oxidation or rusting may occur.

The instrument <u>should be stored</u> in a temperature range of -20° to 70°C, and a humidity range of 40% to 80%. It should be cleaned before storage. The storage area should not be subject to large fluctuations in temperature over a 24-hour period.

If this instrument is operated at room temperature after being used or stored for a long period at low temperatures, condensation may occur and cause short-circuiting. To prevent this do not turn the power on until the instrument is completely dry.

3.2 Power Connections

This measuring receiver can be operated on any power supply of the four types shown in Fig. 3-1, 3-2, 3-3, and 3-4.

3.2.1 Use of dry cell or Ni-Cd battery

(1) Dry cells: Insert the MZ110A Battery Pack (LR14), 1.5 V x 6, standard accessory) into the instrument. (Fig. 3-1).

The operation time of the battery is approximately 20 to 40 minutes.

(2) Rechargeable battery: Insert the MZ110B Battery Pack (Ni-Cd battery, 1.2 V x 6, optional accessory) into the instrument. (Fig. 3-2).

The operation time of the battery is approximately 45 to 90 minutes for ML521/ML522 and 30 to 60 minutes for ML524. It is advisable to have a spare battery pack.
The GP-IB interface cannot be operated on the battery pack.

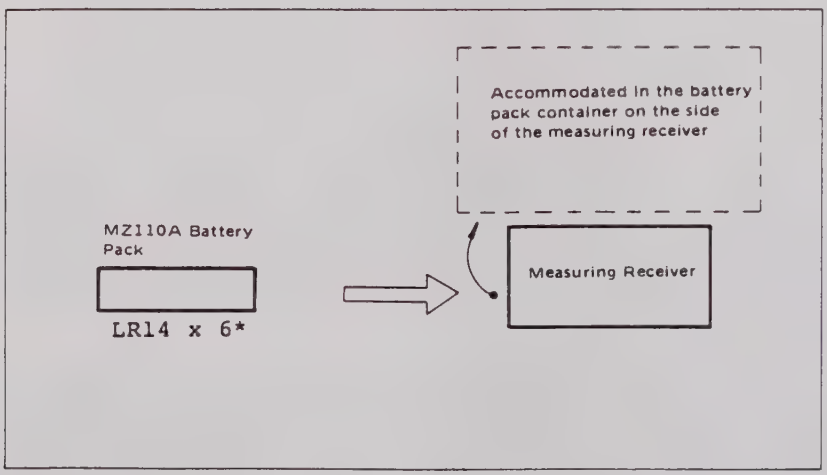

Accommodated in the battery pack container on the side of the measuring receiver
MZ110A Battery Pack
LR14 x 6*
Measuring Receiver

Fig. 3-1 Use of Dry Cell

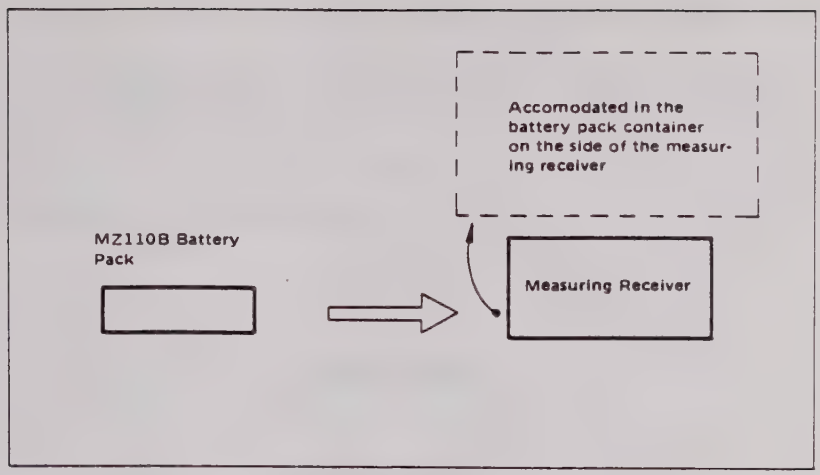

Accomodated in the battery pack container on the side of the measuring receiver
MZ110B Battery Pack
Measuring Receiver

Fig. 3-2 Use of Ni-Cd Battery

When dry cells or Ni-Cd batteries are to be used, insert the MZ110A battery pack or MZ110B Battery Pack into the slot on the left side of the measuring receiver.

The dry cells in the MZ110A Battery Pack should be new, and Ni-Cd batteries in the MZ110B Battery Pack should be fully charged.

Even though the GP-IB interface (option 01) is provided, power cannot be supplied to it from the MZ110A or MZ110B Battery Pack.

When the GP-IB is operated, it requires the MZ114A AC Power Pack as shown in Table 2-3 (1). Close attention should be paid to the polarity when exchanging the dry cells.

3.2.2 Ac power supply connection

External AC: power supply — Use the MZ114A AC Power Pack (optional accessory).

[**] Vac ±10% (max. 250 V), approximately 35 VA (when GP-IB is installed).

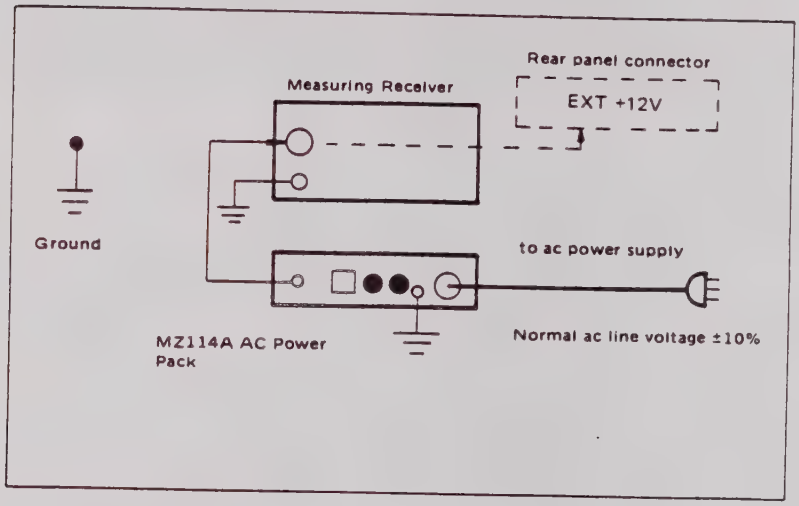


Fig. 3-3 Ac Power Supply Connection

When operating the measuring receiver on the ac power supply, the measuring receiver must always be grounded to prevent an electrical shock hazard caused by leakage from the power line.

Connect the ground terminal of the MZ114A AC Power Pack directly to ground.

When the plug is connected to a receptacle with a 3 line type power line, the direct ground can be omitted.

The above precaution also applies to the MZ115A Battery Charger.

3.2.3 External dc power supply connection

An example of the external dc power supply is the MZ88A DC Power Supply.

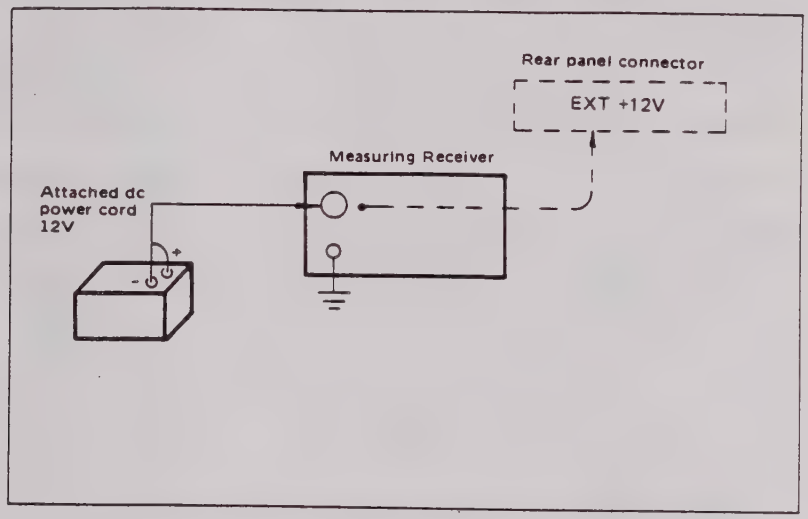


Fig. 3-4 External Dc Power Supply Connection

It is recommended that batteries (the total power consumption being 12 V, approximately 1.3 A) with 3 to 4 Ah or more capacity be used.

Dc 10 to 15 V, approximately 1 A (approximately 1.3 A when the GP-IB is installed). (However, approximately 2 A of the rush current passes when the power is on.)

If the external dc power supply is used, the measuring receiver ground terminal should be grounded depending on the type of power supply used. However, grounding the ground terminal is not required if the power supply is isolated from the power line.

CAUTION

If an independent power source such as a car battery is used, one pole of the battery will be grounded to the car chassis. If the negative pole is grounded there is no problem in correcting the measuring receiver. However, if the positive pole of the car battery is grounded to the chassis, connecting the measuring receiver to the car will short-circuit the car battery. This is because the negative side of the dc power supply connector of the measuring receiver is connected to the ground terminal of the measuring receiver.

3.3 Local Operation

There are two operations for the ML521/ML522/ML524 Measuring Receiver: local operation, and remote operation (GP-IB control) using option 01.

The local operation is set up by manual operation of keys, connectors and indicators on the front and rear panels of the instrument.

This paragraph explains the local operation.

Refer to paragraphs 3.4.3 (2) and 3.4.3 (4) for the antenna select switch setting and factor memory storing and its related matters.

3.3.1 Explanation of controls

Figures 3-5 to 3-7 show the control layout and Table 3-1 lists the functions.

Table 3-1 Front, Rear and Side Panel Control Functions

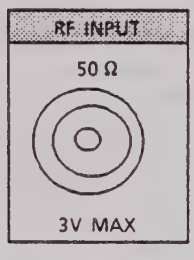
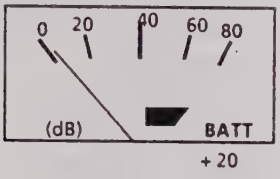
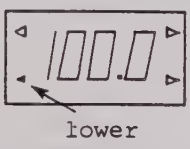
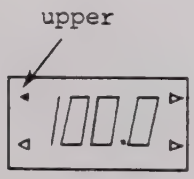
No.	Appearance		Explanation
1		Input connector	: To be connected to an antenna, etc. The allowable maximum level is 3 V.
2		Loudspeaker	: Loudspeaker to monitor sounds.
3		Level meter	: A convenient monitor for fluctuating levels. Input levels from 0 to 80 dBμV can be displayed. When the RF ATT is ON, this meter indicates a value 20 dB lower than the input level. The blue scale is used to check the battery.
4		CAL indicator	: Comes on while level calibration is being executed. This indicator blinks if level calibration is needed.
5		RF ATT indicator	: Blinks if the RF ATT is not inserted and the input level exceeds 80 dBμV. This indicator remains ON if the RF ATT is ON, and blinks if the RF ATT is turned ON when the input level is 50 dBμV or less, means that the RF ATT should be turned OFF. Therefore, correct measurements will only be performed when this indicator is OFF or remains ON.

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

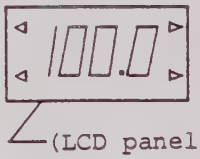
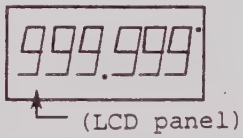
No.	Appearance		Explanation
6		Level display (Liquid Crystal Display (LCD) panel)	: Displays the input level. The level of the field strength can be read directly by dBμV and dBμV/m. If a level in excess of 102 dBμV is applied to the RF ATT, this indicator blinks, indicating an over-input.
7		Voltage indicator:	Indicates the input voltage.
8		Field strength indicator	: Indicates the field strength.
9		Frequency display (LCD panel)	: Displays the set receiving frequency.
10		500 Hz dot indicator	: Comes on when the least significant digits of the set receiving frequency is 500 Hz.
11		Entry key (MHz)	: Inputs the frequency information by the numeric keys and sets the frequency.

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

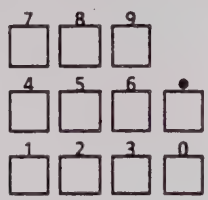
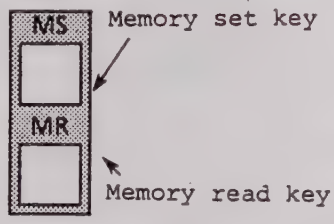
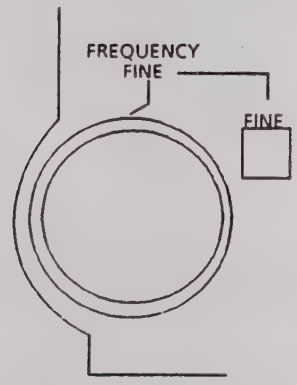
No.	Appearance		Explanation
12		Numeric keys	: Inputs the frequency information. The input information by these keys is displayed on the frequency display.
13 14		Memory set key Memory read key	: Key to memorize the displayed information on the frequency display. : Key to display the memorized frequency information on the frequency display.
15		FINE key	: The FINE dial can be used when this key is ON.
16		FINE dial	: Varies the frequency continuously in 1 kHz or 12.5 kHz steps with this dial. This dial can be used when the FINE key is set to ON, at this time the last one or two digits of the frequency indicator blinks. Varies ML521A.ML522A/C. ML524A/C at 12.5 kHz step, ML521B.ML522B. ML524B at 12.5 kHz step when bandwidth is 120 kHz, and at 1 kHz step when bandwidth is 15 kHz.

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

No.	Appearance		Explanation
17	BW(kHz) 120 15 (B type) BW(kHz) 15 8 (C type)	Passband width changeover switch	: The passband width can be switched. ML521B, ML522B and ML524B can be switched to the middle band (15 kHz) and wide band (120 kHz). ML522C and ML524C can be switched to narrow band (8 kHz) and middle band (15 kHz) (ML521A, ML522A and ML524A are exclusive for wideband).
18	AM FM	Demodulator changeover switch	: AM and FM can be switched.
19	(dBμV) (dBμV/m) UNITS	Unit change-over switch	: Switches the units of the numeric value on the level display by pressing this key. The units are (dBμV) for the voltage (emf) and (dBμV/m) for field strength.
20		Volume control	: The volume control of the loudspeaker or earphone.
21	CAL	CAL key	: The CAL (gain calibration) is performed automatically by pressing this key. The CAL indicator ◀ (in the lower left corner of the level display) comes on during the CAL operation.

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

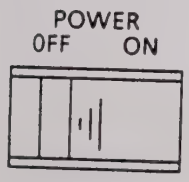
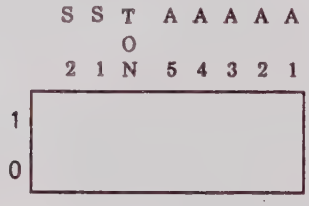
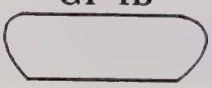
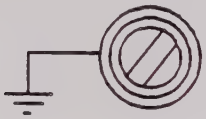
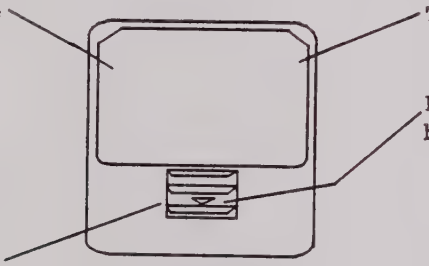
No.	Appearance		Explanation
22		Earphone jack	: A low impedance (for example, 8 Ω) earphone can be used.
23		RF ATT key	: Inserts the RF ATT 20 dB when this key is ON. The RF ATT indicator ◀ in the upper left corner of the level display comes on at this time. Use this key when the RF ATT indicator blinks.
24		Recorder output connector	: Approximately 1 V of output can be obtained at 100 kΩ load when the digital indication is 80 dB.
25		Battery check and LCD (Liquid Crystal Display) panel light switch	: Pressing this switch causes the level meter to indicate the voltage of the built-in battery (if the ac power supply or external power supply is used, then its voltage). The meter showing within the blue mark means normal. A lamp comes on to illuminate the LCD panel.
26		Power switch	
27		Squelch adjuster:	Adjusts the threshold level of squelch.

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

No.	Appearance		Explanation
28	IF OUT (10.7MHz)	IF output connector	: The 10.7 MHz IF output.
29	DISC OUT 	Discriminator output connector	: An output of 1 V ±20% at 100 kΩ load can be obtained when modulation frequency is 2 kHz and frequency deviation is 3.5 kHz.
30		Address switches: (antenna select switch)	A1 through A5 are used to set the address when the GP-IB is used. TON indicates the talker only mode. S1 and S2 are the switches used to select the antenna for field strength measurement. Antenna factors can be selected with this switch. For a description of use of the undefined antenna factor, see paragraph 3.4.3.
31	GP-IB 	GP-IB connector	: The GP-IB (IEEE-488 bus) connector. It is used for option 01. Therefore, this connector will be mounted if option 01 is ordered.

S2	S1	Type of Antenna
0	0	MP534B, MP651B
0	1	MP635A
1	0	Undefined (Part to which antenna factors can be written)
1	1	——

Table 3-1 Front, Rear and Side Panel Control Functions (Cont'd)

No.	Appearance		Explanation
32		Ground terminal	: This terminal should be grounded to prevent electric shock. Ground this terminal when the MZ114A AC Power Pack is used.
33		External power supply connecting connector	: This connector is used to connect the dc power cable when the measuring receiver is to be operated on the external power supply (DC 10 to 15 V).
34 35		This is the slot for the battery pack (Ni-Cd or dry cell). Pressing the knob in the direction indicated by the arrow ejects the battery pack a little.	

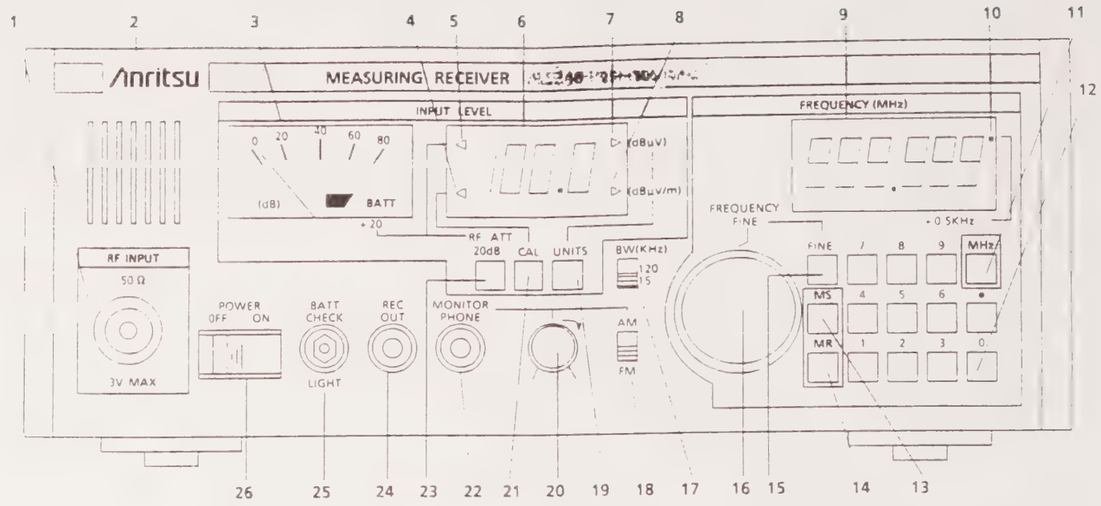


Fig. 3-5 Front Panel

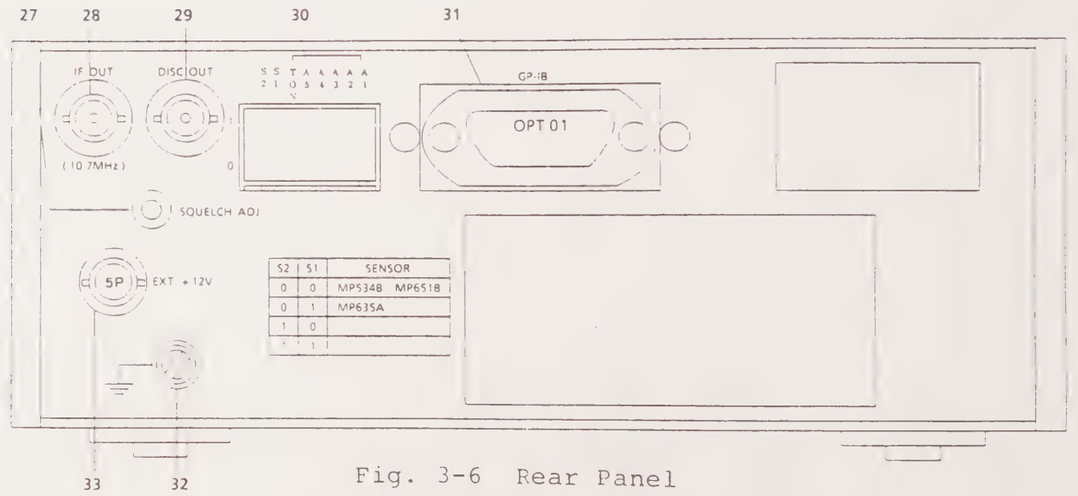


Fig. 3-6 Rear Panel

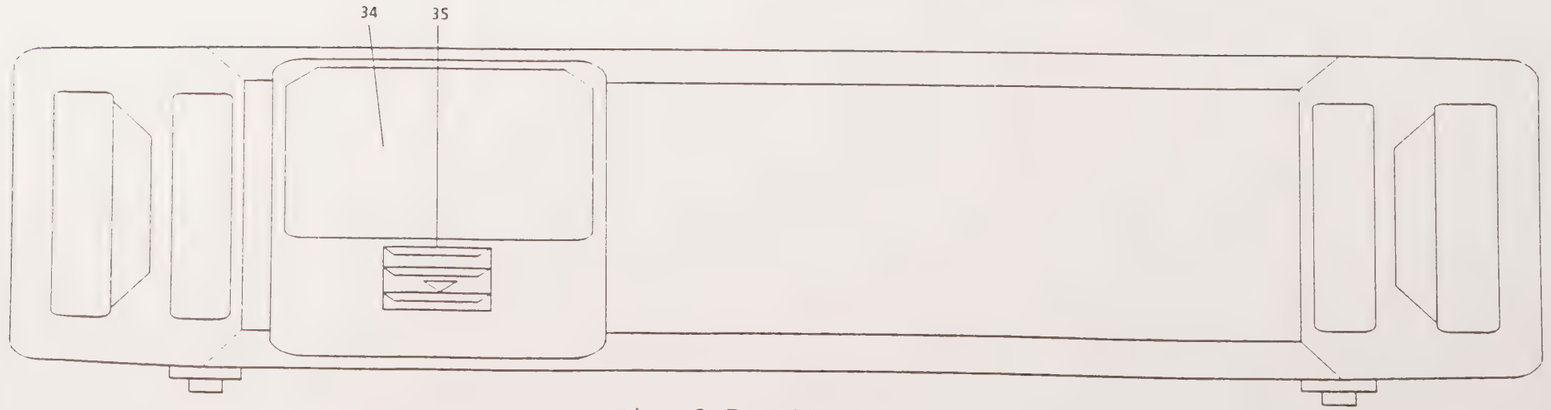


Fig. 3-7 Side Panel

(1) Power

The power is turned on by setting the power switch to the ON side shown in Fig. 3-8.

Accordingly, the following operations are carried out and the check of the memory backup battery is also carried out.

. Automatical CAL

. Display of the set frequency

. Check of the memory backup battery (verified by OFF→ON of the power switch)

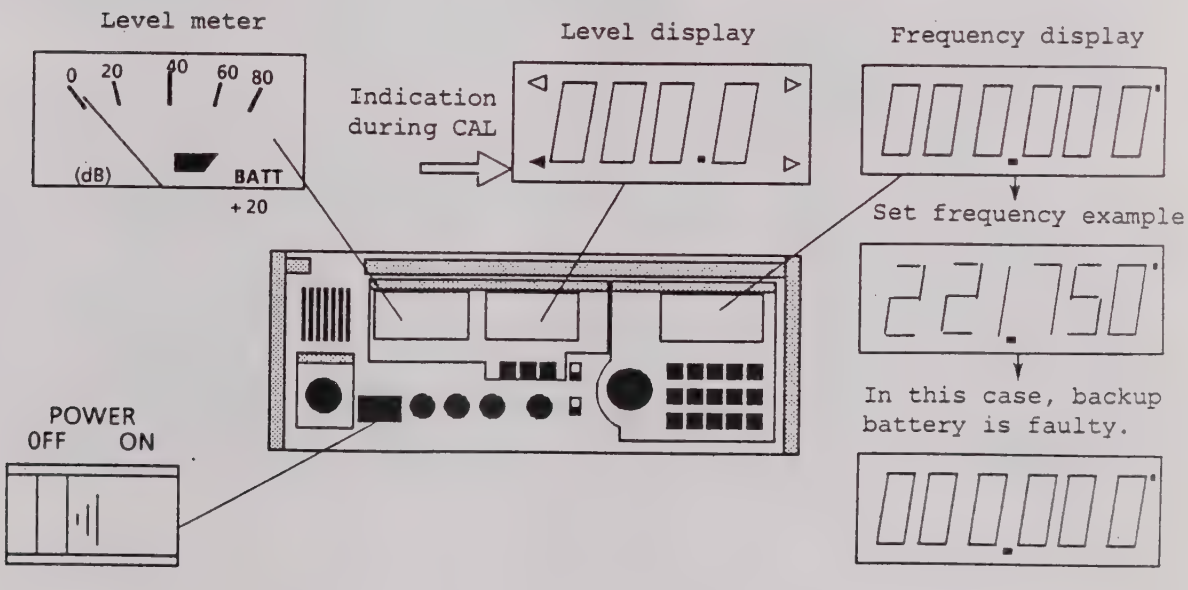


Fig. 3-8 POWER SWITCH OPERATION

STEP	ACTION	VERIFICATION
1	Set the POWER switch to "ON".	When the power is turned on, a "CAL" operation is performed automatically for several seconds, and then the measuring receiver will be ready for measurements. The pointer of the level meter indicates approximately 30 dB during the "CAL" operation. The level display indicates "000.0" after the power switch is on. When the "CAL" is started, the display "000.0" disappears and the ◀ mark at the lower left corner of the level display comes on during "CAL". Numerics are displayed on the level display when the measurement is started after "CAL". On the frequency display, the values that was set prior to this checking, is displayed. If "000.000" is displayed at this time, input the frequency in accordance with the frequency setting method described in paragraph 3.3.1 (6).
2	Set the POWER switch to "OFF". Then, set it back to "ON" again after 3 or more minutes.	If the previous frequency display appears at this time, it indicates that the measuring receiver is operating normally. If "000.000" is displayed, the built-in memory backup batteries may have worn out and, need replacing. (The batteries are replaced at the factory.) However, even if the frequency can be input normally when the power is "ON", there should not be any problem with the measurement. The level display will show approximately 0 dB or more. (This level is caused by noise.)

(2) BATT CHECK/LIGHT

When the BATT CHECK button as shown in Fig. 3-9 is pressed, checking of the battery and illumination of LCD panels (level display, frequency display) are carried out.

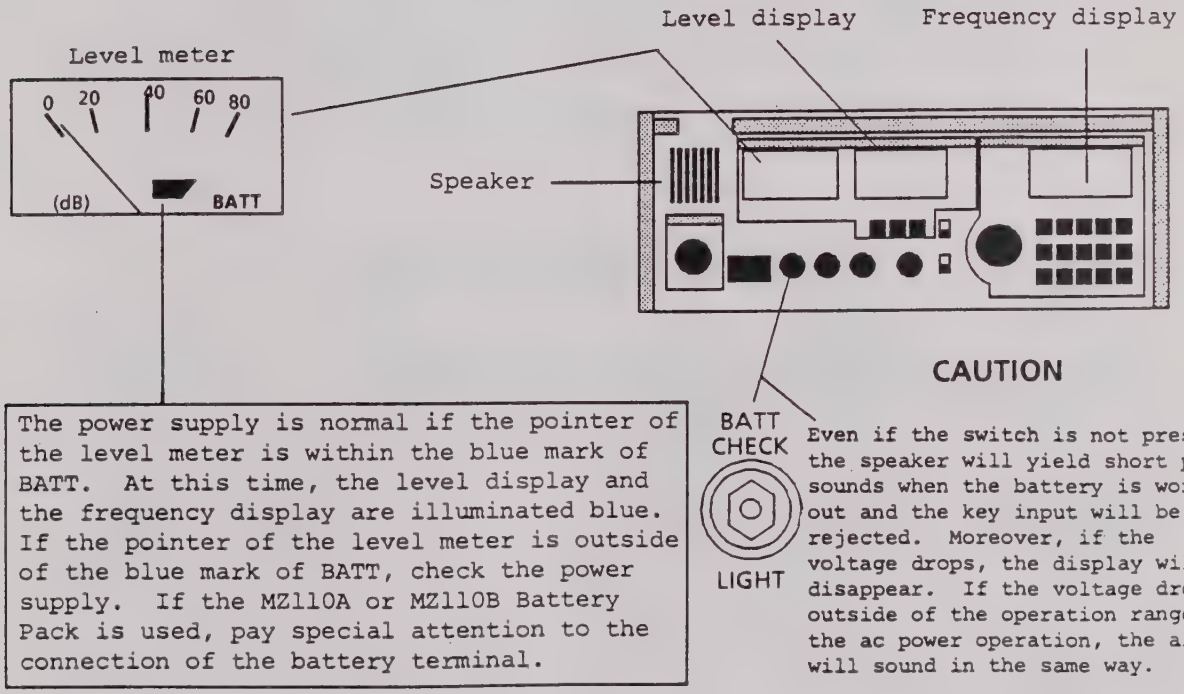

Level display
Frequency display
Level meter
0 20 40 60 80
(dB)
BATT
Speaker
CAUTION
BATT CHECK
LIGHT
The power supply is normal if the pointer of the level meter is within the blue mark of BATT. At this time, the level display and the frequency display are illuminated blue. If the pointer of the level meter is outside of the blue mark of BATT, check the power supply. If the MZ110A or MZ110B Battery Pack is used, pay special attention to the connection of the battery terminal.
Even if the switch is not pressed, the speaker will yield short pip sounds when the battery is worn out and the key input will be rejected. Moreover, if the voltage drops, the display will disappear. If the voltage drops outside of the operation range in the ac power operation, the alarm will sound in the same way.

Fig. 3-9 BATT CHECK/LIGHT Operation

(3) MONITOR

First, MONITOR function can be switched to AM or FM by using the demodulator changeover switch as shown in the figure below.

Either the loudspeaker or the earphone can be used for sound monitoring. However, when using the earphone, the sound from loudspeaker is blocked if the earphone (8 Ω) plug is inserted into the earphone jack.

The volume of the loudspeaker or the earphone is controlled by the volume control.

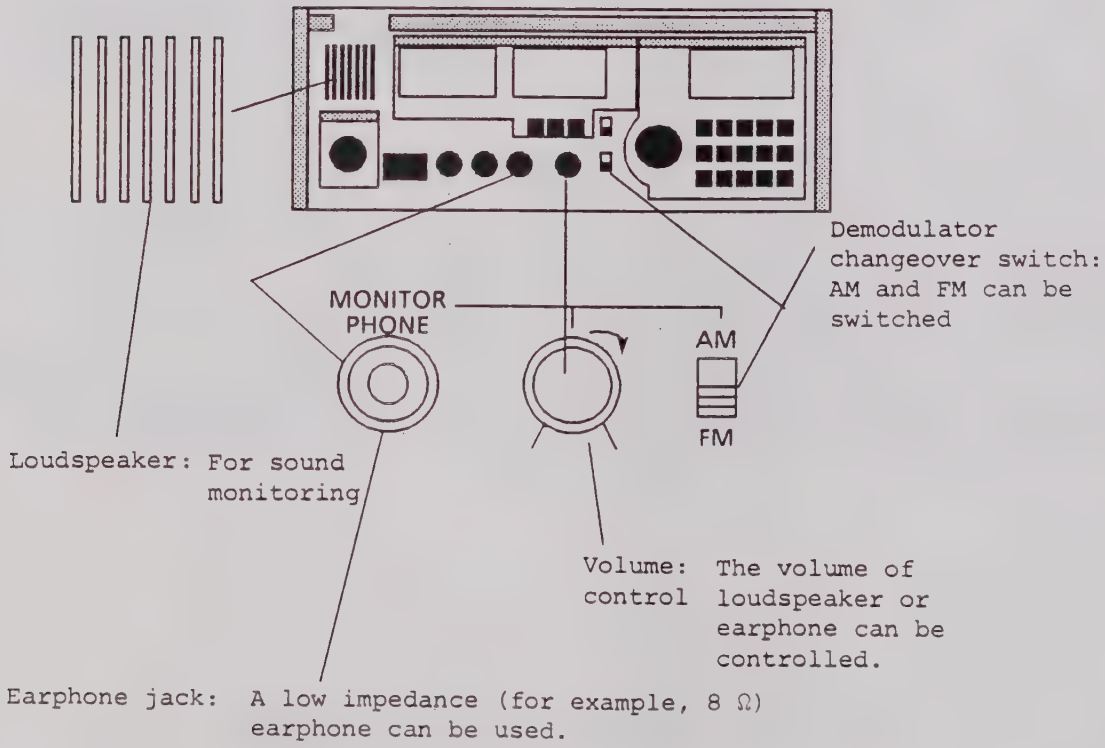

Demodulator changeover switch: AM and FM can be switched
MONITOR PHONE
AM
FM
Loudspeaker: For sound monitoring
Volume: control
The volume of loudspeaker or earphone can be controlled.
Earphone jack: A low impedance (for example, 8 Ω) earphone can be used.

Fig. 3-10 MONITOR FUNCTION

(4) RF INPUT

This input connector is used for the signal input to measure the voltage and the field strength of signal source.

WARNING

A signal exceeding 0.18 W or 22.55 dBm (3 Vrms) should not be applied to the RF INPUT. If an excessive signal is applied, the input circuit may be damaged.

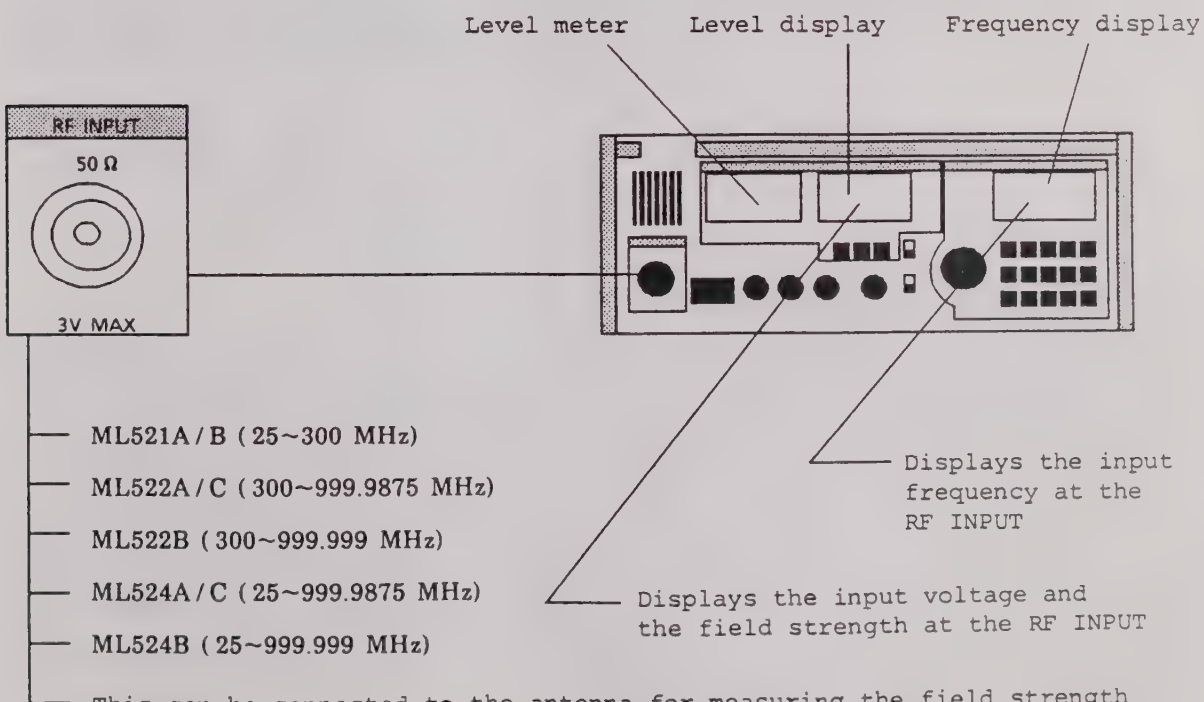

Level meter
Level display
Frequency display
RF INPUT
50 Ω
3V MAX
ML521A/B (25~300 MHz)
ML522A/C (300~999.9875 MHz)
ML522B (300~999.999 MHz)
ML524A/C (25~999.9875 MHz)
ML524B (25~999.999 MHz)
Displays the input frequency at the RF INPUT
Displays the input voltage and the field strength at the RF INPUT
This can be connected to the antenna for measuring the field strength and also to a 50 Ω coaxial line for measuring the voltage.
The voltage measurement unit is open circuit voltage with dB(μV).
The terminated voltage should be reduced by 6 dB.

Fig. 3-11 RF INPUT

NOTE

In measuring the field strength using a measuring antenna, this measuring receiver can display digitally the measured value of the field strength dB (μV/m) directly on the level display. In this case set the antenna select switch on the rear of instrument in accordance with Table 3-1 No. 30 (page 3-12). If the measurement is made with an antenna not listed in Table 2-3 (2), measure the value of voltage dB (μV), and convert it to the field strength by using the antenna conversion coefficient peculiar to that antenna.

(5) INPUT LEVEL

Keys concerned with the level display are the RF ATT 20 dB, CAL and UNITS as shown in Fig. 3-12.

Following is the explanation of each key.

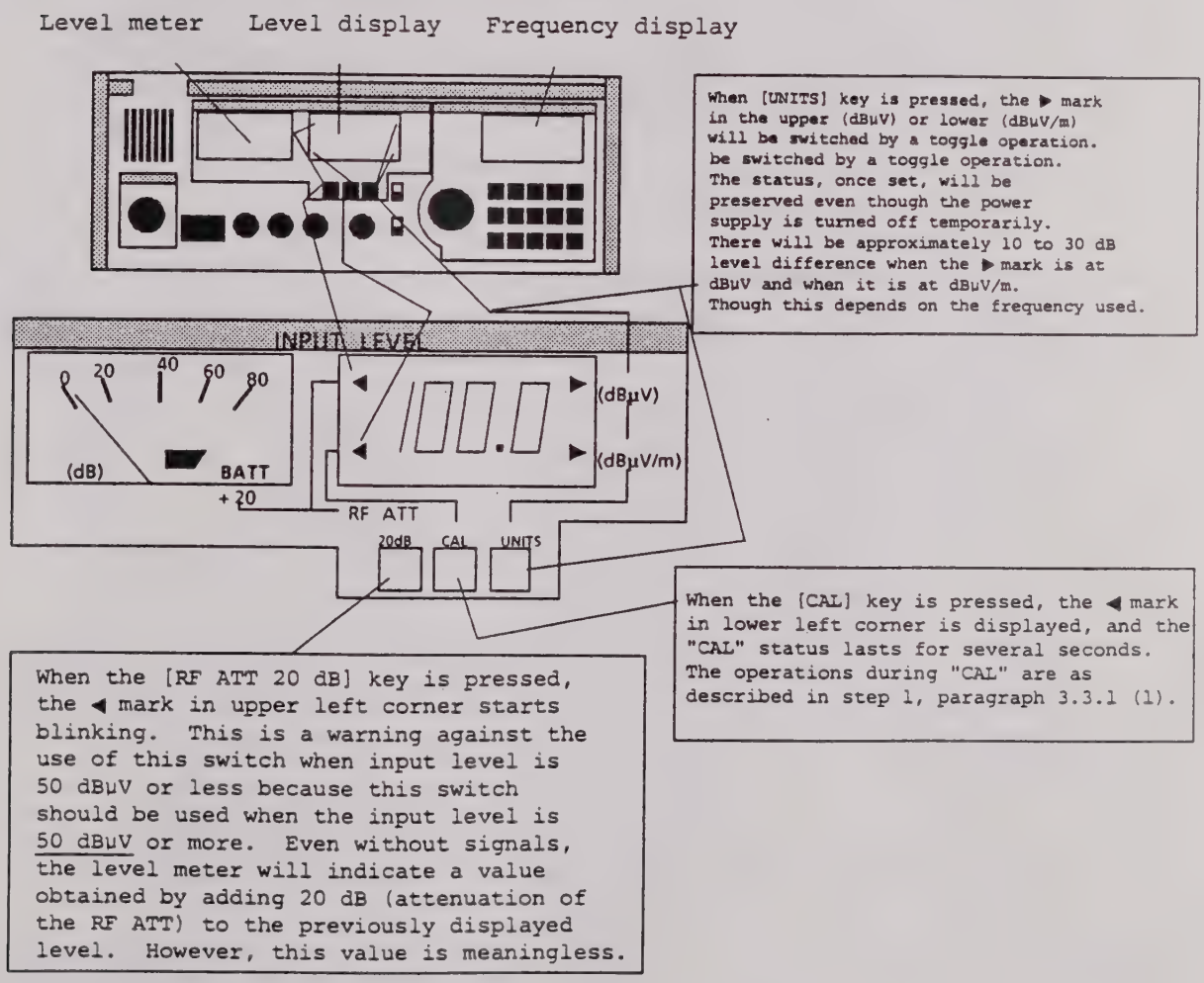

Level meter
Level display
Frequency display
When [UNITS] key is pressed, the ▶ mark in the upper (dBμV) or lower (dBμV/m) will be switched by a toggle operation. be switched by a toggle operation. The status, once set, will be preserved even though the power supply is turned off temporarily. There will be approximately 10 to 30 dB level difference when the ▶ mark is at dBμV and when it is at dBμV/m. Though this depends on the frequency used.
INPUT LEVEL
0 20 40 60 80
(dB)
BATT
+20
(dBμV)
(dBμV/m)
RF ATT
20dB
CAL
UNITS
When the [CAL] key is pressed, the ◀ mark in lower left corner is displayed, and the "CAL" status lasts for several seconds. The operations during "CAL" are as described in step 1, paragraph 3.3.1 (1).
When the [RF ATT 20 dB] key is pressed, the ◀ mark in upper left corner starts blinking. This is a warning against the use of this switch when input level is 50 dBμV or less because this switch should be used when the input level is 50 dBμV or more. Even without signals, the level meter will indicate a value obtained by adding 20 dB (attenuation of the RF ATT) to the previously displayed level. However, this value is meaningless.

Fig. 3-12 INPUT LEVEL FUNCTION

(6) FREQUENCY (MHz)

The following 5 functions are provided.

1) Display of the set frequency ------- Frequency display

2) Setting of the frequency to be measured ----- Numeric key + entry key [MHz]

3) Memory store of the set frequency ------- [MS] key

4) Call the frequency memory at the frequency display ------ [MR] key

5) Fine-adjustment of the frequency ---------- [FINE] key + FINE dial

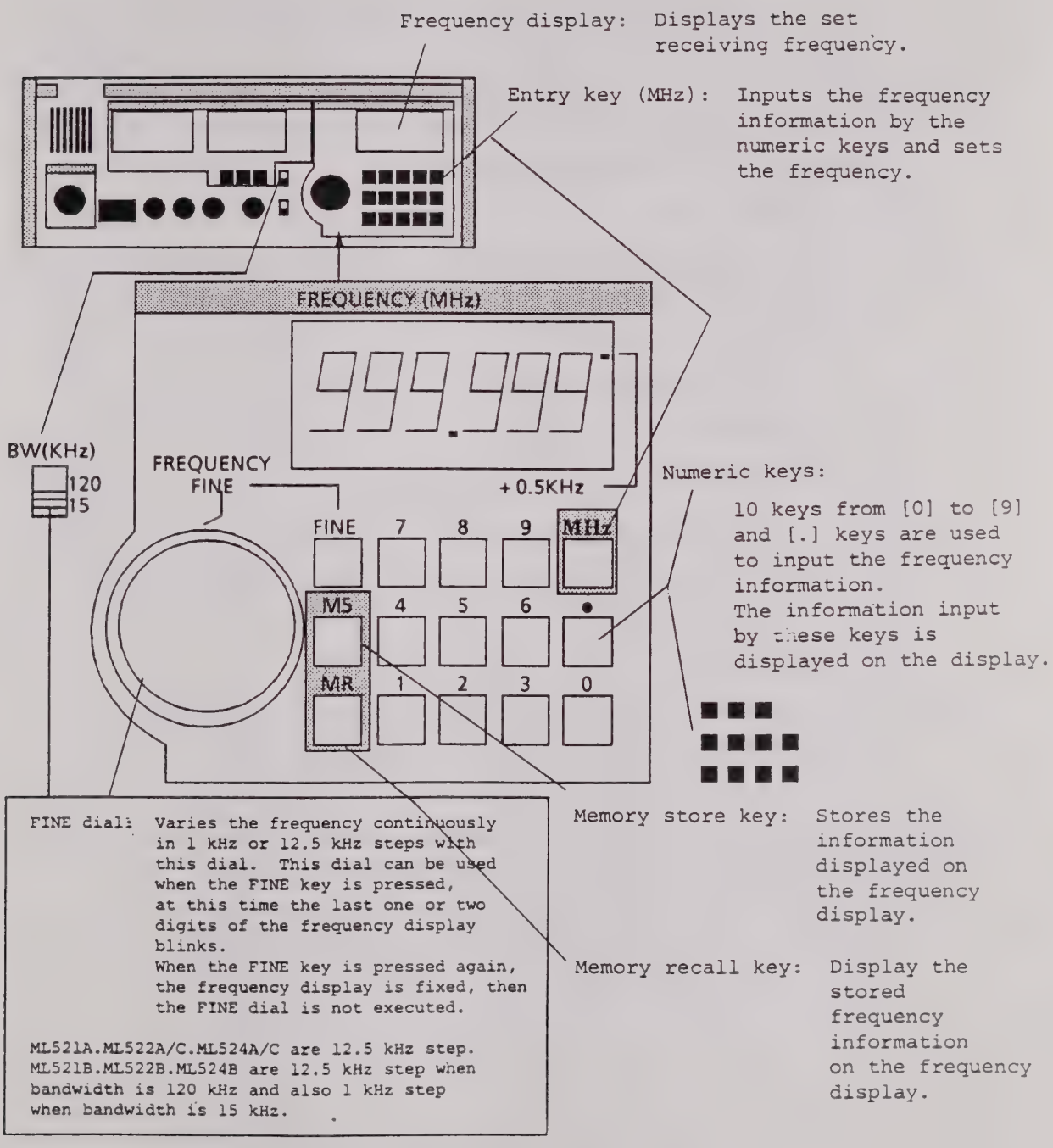

Frequency display: Displays the set receiving frequency.
Entry key (MHz): Inputs the frequency information by the numeric keys and sets the frequency.
FREQUENCY (MHz)
999.999
BW(KHz)
120
15
FREQUENCY FINE
+0.5KHz
FINE
7
8
9
MHz
MS
4
5
6
MR
1
2
3
0
Numeric keys:
10 keys from [0] to [9] and [.] keys are used to input the frequency information.
The information input by these keys is displayed on the display.
FINE dial: Varies the frequency continuously in 1 kHz or 12.5 kHz steps with this dial. This dial can be used when the FINE key is pressed, at this time the last one or two digits of the frequency display blinks.
When the FINE key is pressed again, the frequency display is fixed, then the FINE dial is not executed.
ML521A.ML522A/C.ML524A/C are 12.5 kHz step.
ML521B.ML522B.ML524B are 12.5 kHz step when bandwidth is 120 kHz and also 1 kHz step when bandwidth is 15 kHz.
Memory store key: Stores the information displayed on the frequency display.
Memory recall key: Display the stored frequency information on the frequency display.

Fig. 3-13 FREQUENCY FUNCTION

The frequency of the instrument can be set either using the numeric keys or using the FINE dial as shown in Fig. 3-13.

The following is detailed information for numeric key, FINE dial, and frequency memory:

(a) Numeric key

When the POWER switch is set to ON, the frequency set prior to turning off the POWER switch will be displayed (set).

A new frequency may be set on the following procedure:

Step	Procedure
1	Input the first two or three digits (unit of MHz) using the numeric keys.
2	Press the decimal point key.
3	Input the last three (unit of kHz) or four digits (unit of 500 Hz) using the numeric keys.
4	Press the MHz key.

Table 3-2 Input Frequency Range

Pass-band width (kHz)	Model		
	ML521	ML522	ML524
120	fs=25.000 + n x 12.5kHz [25 ≦ fs ≦ 300MHz]	fs=300.000 + n x 12.5kHz [300 ≦ fs < 1000MHz]	fs=25.000 + n x 12.5kHz [25 ≦ fs < 1000 MHz]
15 (for type B only)	fs=25.000 + n x 1kHz [25 ≦ fs ≦ 300MHz]	fs=300.000 + n x 1kHz [300 ≦ fs < 1000MHz]	fs=25.000 + n x 1kHz [25 ≦ fs ≦ 1000MHz]
8 (for type C only)	——	fs=300.000 + n x 12.5kHz [300 ≦ fs < 1000MHz]	fs=25.000 + n x 12.5kHz [25 ≦ fs < 1000MHz]

n = 0, 1, 2, ... n

If a frequency other than a normal one is input, an error noise will be heard and the previous frequency will be displayed.

If the numeric value to be input does not satisfy the expression shown in Table 3-2, the value is converted and displayed in accordance with the rules shown in Table 3-2.

Table 3-3 Input Value Conversion Table

(a) When the passband width is 15 kHz

The numeric values of a 100 Hz digit are rounded up as follows.

Example:	Input:	After conversion:
1)	100.0014 ⟶	100.001
2)	100.0015 ⟶	100.002

(b) When the passband width is 120 or 8 kHz

Example:	Input:	After conversion:
	876.7639 ⟶	876.7625

Last 3 digits of input value	Converted value
051 to 175	→125
176 to 300	→250
301 to 425	→375
426 to 550	→500
551 to 675	→625
676 to 800	→750
801 to 925	→875
926 to 1050	→1000

Input examples are shown in Table 3-4.

Table 3-4 Frequency Input Examples

Input example A		Input example B		Input example C	
Display	Key input	Display	Key input	Display	Key input
9	9	8	8	9	9
9 0	0	8 7	7	9 0	0
9 0 0	0	8 7 0	0	9 0 0	0
9 0 0	.	8 7 0	.	9 0 0	.
9 0 0 5	5	8 7 0 1	1	9 0 0 1	1
9 0 0 5 8	8	8 7 0 1 0 0	MHz	9 0 0 1 2	2
9 0 0 5 8 1	1			9 0 0 1 2 5	5
9 0 0 5 8 7 ■	MHz			9 0 0 1 2 5	MHz

Input example A shows how the input values are converted and displayed in accordance with Table 3-3 (when the passband width is 120 kHz).

Input example B shows an example where the input of the 10 kHz digit and below is omitted.

Input example C shows normal inputs (when the passband width is 120 kHz).

Erroneous input

If the first three digits (the MHz digits) are erroneously input, they can be corrected by inputting a correct value immediately thereafter as shown in Table 3-5.

Table 3-5 Examples of Erroneous Input

Display	Kye input	
8 7 5 7 7 5		(original frequency)
9	9	
9 0	0	
9 0 0	0	
9 0 0	.	
9 0 0 2	2	
9 0 0 2 3	3	
9 0 0 2 3 4	4	
9 0 0 2 3 4	■ 5	(10 seconds later)
8 7 5 7 7 5		

If the digits other than the first three digits (100 kHz or below) are erroneously input, the correct frequency must be input from the beginning after pressing the MHz key. If the MHz key is not pressed after inputting 7 digits, the original frequency will be resumed in approximately 10 seconds (see Table 3-6).

Table 3-6 Correction of Erroneous Input

Display	key input
6	6←Erroneous input
6 8	8←Correct input
6 8 7	7
8 7 0	0
8 7 0	.
8 7 0 1	1
8 7 0 1 7	7
8 7 0 1 7 5	5
8 7 0 1 7 5	MHz

(b) FINE dial

For continuously varying the frequency in steps, first press the [FINE] key, and then manipulate the FINE dial. In this case the display of digit to be varied blinks.

When the FINE dial is turned continuously in one direction, the ◄ mark of the CAL display blinks. Since level measurement accuracy is not guaranteed in this state, perform level calibration by pressing the [CAL] key. However, when measuring a signal of unknown frequency, receive the signal by turning this dial continuously, then press the [CAL] key.

(c) Frequency memory

Up to 100 waves (100 channels) of frequencies can be stored in this measuring receiver, and any of them can be called with a simple key operation. Table 3-7 shows the method.

Store

(1) Set frequency "1" (in accordance with the method shown in Table 3-4).

(2) Press the numeric key 1.

(3) Press the MS key (Frequency "1" will be stored in address 1).

(4) Set frequency "2".

(5) Press the numeric key 2.

(6) Press the MS key (Frequency "2" will be stored in address 2).

Recall

(1) Press the numeric key 1.

(2) Press the MR key. Frequency "1" will be recalled.

(3) Press the numeric key 2.

(4) Press the MR key. Frequency "2" will be recalled.

Table 3-7 Use of Memory

		Display	key input
Storing	(1)	9 0 0 1 6 2 ■	(Frequency "1")
	(2)	1	1
	(3)	9 0 0 1 6 2 ■	MS (Memory Store)
	(4)	9	9
		9 0	0
		9 0 0	0
		9 0 0	.
		9 0 0 0 0 0	MHz (Frequency "2")
	(5)	2	2
	(6)	9 0 0 0 0 0	MS (Memory Store)
Recalling	(1)	1	1
	(2)	9 0 0 1 6 2 ■	MR (Memory Recall)
	(3)	2	2
	(4)	9 0 0 0 0 0	MR (Memory Recall)

3.3.2 Measurement

This paragraphs describe the method of measuring the voltage and the field strength which are the basic measurement items of this measuring receiver. For remote measurement using the GP-IB, refer to paragraphs 3.4.1 and 3.4.2.

(1) Voltage measurement

The voltage measurement measured EMF of the 50 Ω signal source impedance. The unit is dBμV (0 dB: 1 μV is standardized) and the open circuit voltage is Vo. Therefore, conversion to the terminated voltage V+ is reduced from the measured value as shown below.

(a) Voltage measurement specifications

Model	Minimum		Maximum value
	25 to 300 MHz	300 to 999.999 MHz	25 to 999.999 MHz
ML521A	14 dBμV	-	100 dBμV However, ML521/ ML522 is in frequency range of the minimum value
ML521B	5 dBμV	-	
ML522A	-	14 dBμV	
ML522B	-	5 dBμV	
ML522C	-	2 dBμV	
ML524A	14 dBμV	14 dBμV	
ML524B	5 dBμV	5 dBμV	
ML524C	5 dBμV	2 dBμV	

WARNING

The maximum voltage that can be measured is 100 dBμV (terminated voltage: 50 mV) as shown in the table. If the voltage to be applied to the RF INPUT terminal exceeds 3 Vrms (0.18 W), the input circuit may be damaged. In addition, the level display blinks to indicate overinput when the applied voltage exceeds 102 dBμV.

(b) Setup

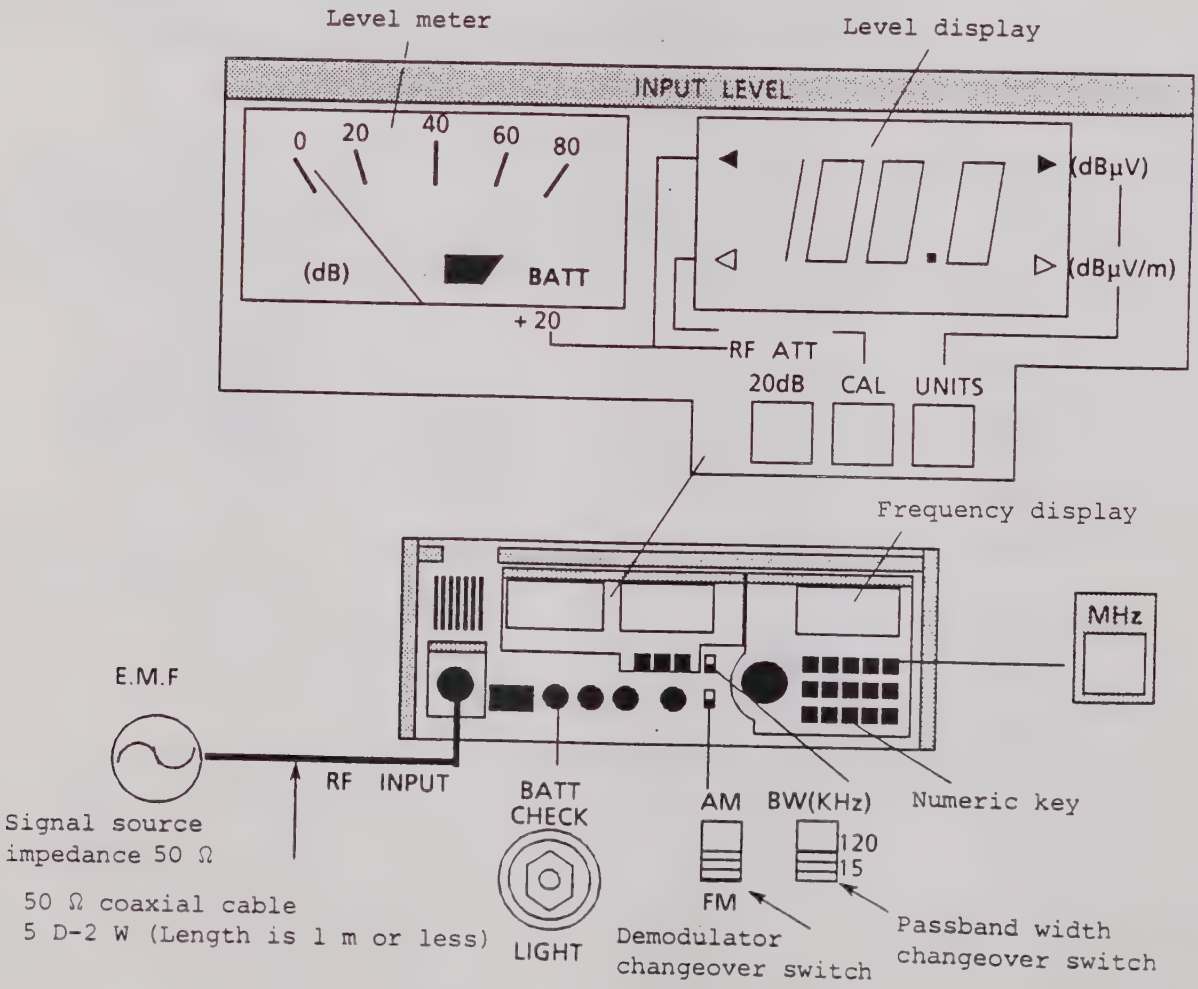


Fig. 3-14 Voltage Measurement

(c) Procedure

Step	Procedure
1	Connect the signal source to be measured to the RF INPUT, set the POWER switch to ON.
2	Press the BATT CHECK and check the supply voltage. It is normal if the pointer of level meter is within the BATT scale. At this time, the LIGHT switch will also be activated to illuminate the level display and the frequency display.
3	Press the [UNITS] key so that the ▶ mark (dBμV) at the upper right of the level display brights.
4	Set the AM, FM demodulator changeover switch to AM or FM according to the signal to be measured.
5	Set the BW (kHz) passband width changeover switch to 15 or 120. (C type to 8 or 15.)
6	Set the receiving frequency using the numeric keys [0] to [9] and the entry key [MHz]. The frequency is displayed on the frequency display.
7	Press the [CAL] key. Level calibration is performed automatically. After the end of calibration, the instrument enters the measurement state and the RF voltage applied to the RF INPUT is displayed in dBμV (e.m.f.) on the level display.

CAUTION

If the RF ATT indicator in the upper left corner of the level display blinks at step 7, it means that the input signal level exceeds 82 dBμV (the maximum measurable level without the RF ATT). Press the [RF ATT] key in this case.

The level display displays the RF voltage applied to the RF INPUT in dBμV (emf). If the RF ATT is used, 20 dB of attenuation of the RF ATT is added and displayed on the level display, by which the level can be read directly.

However, the level meter indicates a value without the attenuation of the RF ATT. Therefore, the input level can be obtained by adding 20 dB to the value indicated on the level meter. The relationship between the level display and the meter indication is shown in Table 3-8.

Table 3-8 Level display

Input level (dBμV)	RF ATT (dB)	Level meter (dB)	Level display (dBμV)
0 to 80	0	0 to 80	0 to 80
50 to 100	20	30 to 80	50 to 100*

* If a level in excess of 102 dB is applied, the number blinks indicating an overinput.

(2) Field strength measurement

There is no basic difference between the field strength measurement method and that of voltage measurement except for the following three points:

1. Preset the antenna select switch. (example is on the MP534B)
2. Connect the antenna connection cable to the RF INPUT connector.
3. Set the UNITS key to dBμV/m.

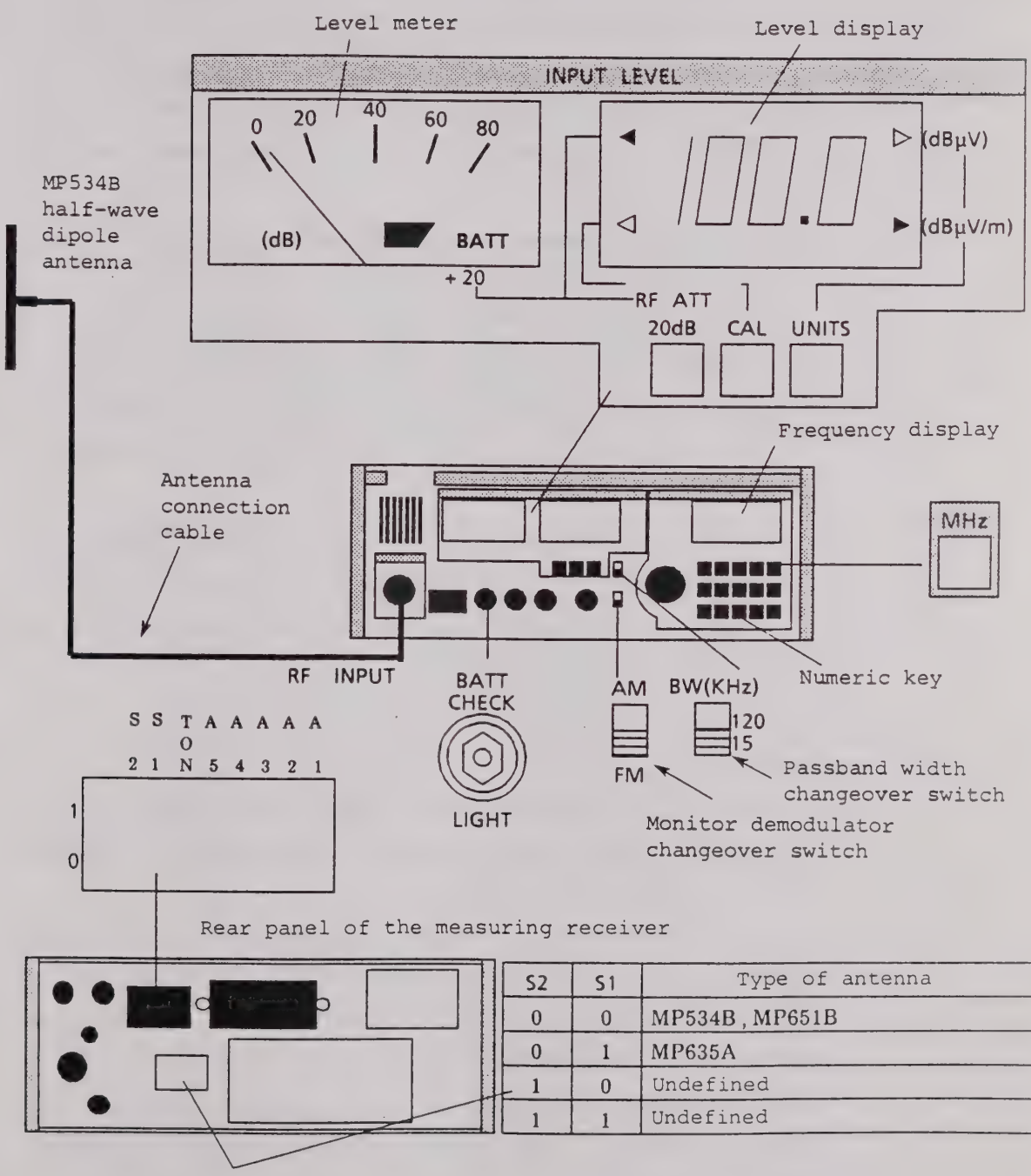
(a) Field strength measurement specifications

Model	Minimum value		Maximum value		bandwidth	C/N	Antenna type
	25 to 300 MHz	300 to 999.999 MHz	25 to 300 MHz	300 to 999.999 MHz			
ML521A	4 to 28 dBμV/m	—	90 to 114 dBμV/m	—	120 kHz	≧6dB	Half-wave dipole
ML521B	-5 to 19 dBμV/m	—		—	15 kHz		
ML522A	—	28 to 41 dBμV/m	—	114 to 120 dBμV/m	120 kHz		
ML522B	—	19 to 32 dBμV/m	—		15 kHz		
ML522C	—	16 to 29 dBμV/m	—		8 kHz		
ML524A	4 to 28 dBμV/m	28 to 41 dBμV/m	90 to 114 dBμV/m	114 to 120 dBμV/m	120 kHz		
ML524B	-5 to 19 dBμV/m	19 to 32 dBμV/m			15 kHz		
ML524C		16 to 29 dBμV/m			8 kHz		

CAUTION

When a field strength measurement of more than 120 dBμV/m is required, set the measuring receiver, antenna connection cable and an attenuator in the electrically shielded room and measure the field strength. Such high field strength should be measured by attenuating it using an attenuator.

(b) Setup



S2	S1	Type of antenna
0	0	MP534B, MP651B
0	1	MP635A
1	0	Undefined
1	1	Undefined

Fig. 3-15 Field Strength Measurement

(c) Procedure

Step	Procedure
1	Since the antenna is MP534B, set the address switches S1 and S2 at the left side of the rear panel as shown in Fig. 3-15 (0,0).
2	Connect the antenna connection cable to the RF INPUT and set the POWER switch to ON.
3	Press the BATT CHECK and check the supply voltage. It is normal if the pointer of the level meter is within the BATT check scale. At this time, the LIGHT switch is also activated to illuminate the level display and frequency display.
4	Press the [UNITS] key so that the ▶ mark (dBμV/m) at the lower right corner of the level display brights.
5	Set the AM, FM monitor switch to AM or FM according to the signal to be received.
6	Set the BW (kHz) passband width switch to 15, 120 or 8. (Type C is 8.)
7	Set the receiving frequency using the numeric keys [0] to [9] and [MHz] key. The set frequency is displayed on the frequency display.
8	Press the [CAL] key. Level calibration is performed automatically. After the end of calibration, the instrument enters the measurement state and the field strength is displayed on the level display. The conversion of field strength is not carried out on the level meter, the input voltage from the antenna is displayed as it is.

CAUTION

If the RF ATT indicator at the upper left corner of the level display blinks during step 8, it means that the input signal level exceeds the maximum measurable level without the RF ATT. Press the [RF ATT] key in this case.

The RF voltage applied to the RF INPUT is converted to field strength and displayed on the level display. If the RF ATT is used, since the attenuator of the RF ATT is not added to the level meter indication, adding 20 dB to the level meter indication is the input level when the RF ATT indicator is lit continuously.

NOTE

Since the level display indicates the level with 0.1 dB precision, it can be used in normal measurement with high precision. The level meter is used to search for the maximum or minimum values of levels while adjusting the antenna position.

3.4 GP-IB CONTROL

This section explains remote control measurement using the GP-IB. The following seven functions can be remotely controlled at the measuring receiver:

(1) Frequency setting

(2) Level calibration

(3) Transmission of the level data information

(4) Transmission of the set frequency information

(5) RF ATT (20 dB) ON/OFF

(6) dBμV specification of the output data unit

(7) dBμV/m specification of the output data unit

General programming of these items is explained in the first half of this section; the antenna factor storing method is explained in the latter half.

3.4.1 Precautions before using the GP-IB

Before executing GP-IB remote control, the GP-IB cable must be connected and the GP-IB address must be set. Fig. 3-16 shows the locations of the GP-IB address switch and GP-IB cable connection on the rear panel.

Setting the GP-IB address and connecting the GP-IB cable must be carried out before turning the power on (see cautions below).

(1) Connecting and disconnecting the GP-IB cable

WARNING

The GP-IB cable should only be connected or disconnected after the power switch is turned off and the power cord is removed.

Note that the cable's Signal Common line may be cut before other lines depending on how the cable was connected or disconnected. In such cases, the ac leak voltage will overlap in the ICs if power is turned on, and such circuit components as interface unit ICs may be damaged.

(2) Setting the GP-IB address

CAUTION

The GP-IB address should generally be set before power is turned on. Then, when power is turned on, the address set by the address switch is read.

Even if the address switch is set as shown in Fig. 3-16 with power turned on, the previously set value remains stored instead of the newly set address value.

When the ML521/522/524 is controlled by GP-IB using an NEC personal computer(the PC98 series), set the GP-IB address of the PC98 series to other than 0.

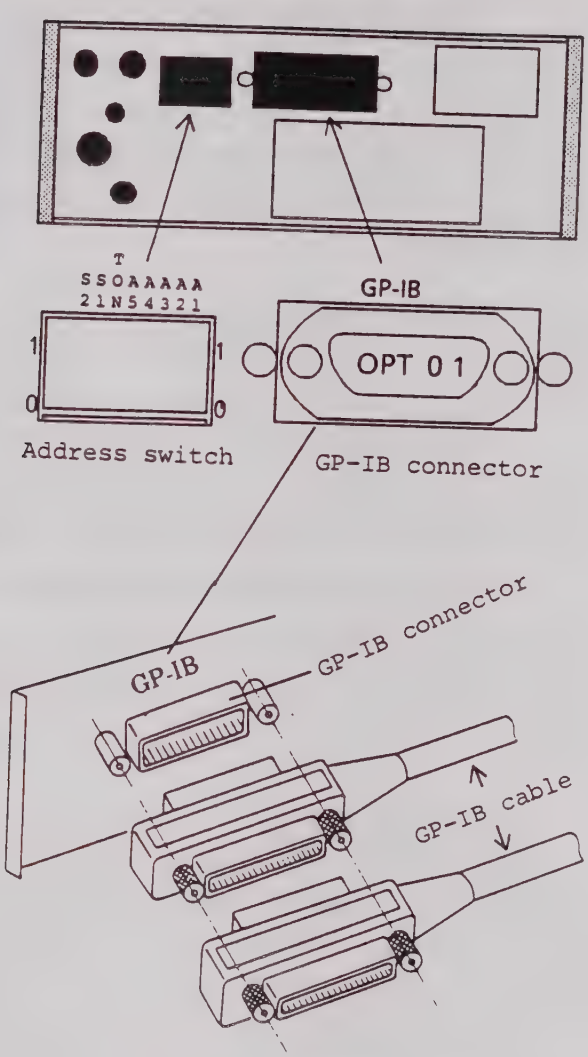


Fig. 3-16 Connection of the GP-IB Cable and address setting switch

Table 3-9 GP-IB Address Code

Address character		Set of address switch					Primary address
Talk	Listen	5	4	3	2	1	
b_7 b_6	b_7 b_6	b_5	b_4	b_3	b_2	b_1	
1 0	0 1	↓	↓	↓	↓	↓	Decimal
@	SP	0	0	0	0	0	0
A	!	0	0	0	0	1	1
B	"	0	0	0	1	0	2
C	#	0	0	0	1	1	3
D	$	0	0	1	0	0	4
E	%	0	0	1	0	1	5
F	&	0	0	1	1	0	6
G	'	0	0	1	1	1	7
H	(	0	1	0	0	0	8
I	)	0	1	0	0	2	9
J	*	0	1	0	1	0	10
K	+	0	1	0	1	1	11
L	,	0	1	1	0	0	12
M	-	0	1	1	0	1	13
N	.	0	1	1	1	0	14
O	/	0	1	1	1	1	15
P	0	1	0	0	0	0	16
Q	1	1	0	0	0	1	17
R	2	1	0	0	1	0	18
S	3	1	0	0	1	1	19
T	4	1	0	1	0	0	20
U	5	1	0	1	0	1	21
V	6	1	0	1	1	0	22
W	7	1	0	1	1	1	23
X	8	1	1	0	0	0	24
Y	9	1	1	0	0	1	25
Z	:	1	1	0	1	0	26
[	;	1	1	0	1	1	27
\	<	1	1	1	0	0	28
]	=	1	1	1	0	1	29
∩	>	1	1	1	1	0	30

The measuring receiver's GP-IB address is set to "5" when shipped from the factory. (Option 01)

To use addresses other than address "5", reset addresses from "0" to "30" as listed in Table 3-9.

The following example explains how to set address "5" to "26". (See Fig. 3-17 (a) and Fig. 3-17 (b).)

Step	Procedure
1	Set the POWER switch to OFF.
2	Remove the power cord.
3	Disconnect the GP-IB cable from the GP-IB connector. Explanation of the address switch Figure 3-17 shows an enlarged model diagram of the address setting part of the address switch shown in Fig. 3-16. Set these switches to the upper side for bit level "1" and to the lower side for bit level "0", respectively. In addition, MSB is the leftmost "5" and LSB is the rightmost "1".
4	Because address 26 (decimal) is expressed as 11010 in binary as listed in Table 3-9, set the switches 5, 4, and 2 shown in Fig. 3-17 (b) to the level "1" side. In addition, set the switches 3 and 1 to the level "0" side. (See Fig. 3-17 (b).)
5	Reconnect the power cord and the GP-IB cable.

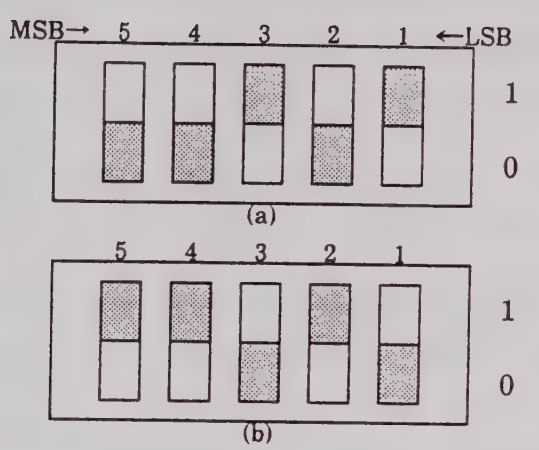


Fig. 3-17 Address Setting

3.4.2 GP-IB Control

The General-Purpose Interface Bus (GP-IB) is formally known as the IEEE-488 Interface Bus, and is used to control measurement instruments. The RS-232C Centronics interface is commonly used to connect personal computers with peripheral equipment. However, there are restrictions on the types of equipment and instruments that the RS-232C Centronics can be connected to. In addition, the RS-232C Centronics cannot be connected to several peripheral devices at the same time.

Conversely, the GP-IB can control up to 15 peripheral devices at one time. Because the peripheral devices controlled via the GP-IB are connected in parallel, these devices must be identified. Device selections for the GP-IB are made by using settings 0 to 30 (see Table 3-9). Note that only these devices that have been selected can communicate with the personal computer.

The peripheral devices being controlled via the GP-IB have their own control codes. For example, the ML521/ ML522/ML524 use the device function codes listed in Table 3-10. By setting these function codes for specific devices, the specified device functions can be activated. For example, by setting the "CL' code, level calibration can be done. The activiation is the same as when the CAL switch on the front panel of the ML521/ML522/ML524 is pressed. Most front panel functions of the ML521/ML522/ ML524 can be controlled via GP-IB as shown in Table 3-10.

Function codes are transferred from the personal computer to peripheral devices by executing a BASIC program that specifies the function codes.

The specific version of BASIC used by personal computers varies depending on the personal computer used, especially in terms of the method of programming for GP-IB control.

From the standpoint of the devices to be controlled, the control codes sent from the personal computer vary depending on the type of computer used. Consequently, adaptability is a problem. In the worst case this problem cannot be solved only by BASIC programming.

GP-IB control of the ML521/ML522/ML524 is fully guaranteed (against the above problem) when using Packet series (IIe/III/IIIs/V) personal computers.

The programming for controlling the GP-IB when using Packet series personal computers is very simple. When the computer is the talker (send side) and the device is the listener (receiver side), the WRITE statement is used. Conversely, when the computer is the listener (receive side) and the device is the talker (send side), the READ statement is used. These statements are directly used without requiring special commands, which simplifies programming.

Personal computers other than Packet series (IIe/III/IIIs) computers require special programming that must be done according to the related computer's instruction manual.

(1) Connection to the personal computer

Figure 3-18 shows the setup of GP-IB system. The GP-IB control can be operated only when the external power supply is used (i.e. it cannot be operated by a battery pack). Use either the attached MZ114A AC Power Pack or a dc power supply with an output of approximately +12 V, 1.3 A as the external power supply.

CAUTION

A major problem when using personal computers is the noise wave interference that is generated from the computer.

The three causes of noise waves are the power supply line, the GP-IB cord, and noise waves generated directly from the computer's cabinet.

To prevent the generation of such noise waves, antennas must be kept away from the personal computer, GP-IB cord, and ac power line.

The directivity of the antenna can also be utilized by adjusting the antenna or moving the device to another location to minimize noise interference.

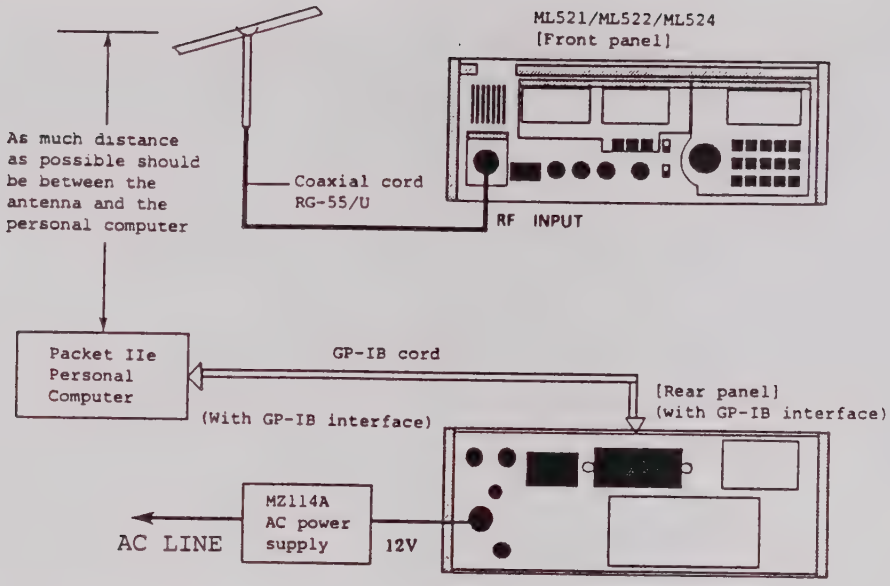


Fig. 3-18 Connection to Personal Computer

(2) Address No. setting

The ML521/ML522/ML524 address must be preset. The address is the sum of the five address bit codes A1 to A5.

For example:

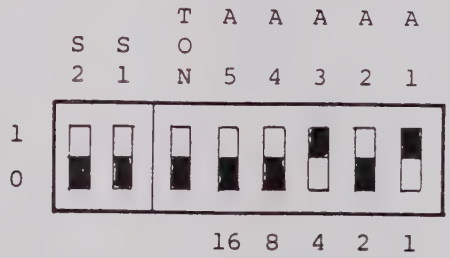


Fig. 3-19 Address Switch

In this example, 1 + 4 = 5, that is the address number is 5. (S1 and S2 are the antenna select switches to be used in field strength measurement, which are not related directly to the operation of the GP-IB.)

(3) Device function codes

The following functions can be controlled by using the GP-IB:

1. Frequency setting
2. Level calibration
3. Output of level data information
4. Output of set frequency information
5. RF ATT (20 dB) ON/OFF
6. Specification of output data as voltage (dBμV)
7. Specification of output data as field strength (dBμV/m)

Table 3-10 lists the device function codes.

Table 3-10 Device Function Codes

Code	Function	Remarks
CF	Start setting the frequency	CF Δ ␣␣␣␣␣␣␣␣␣ (, / , / CR LF)
CL	Execute CAL	CL (, / , / CR LF)
OL	Output the level	OL (, / , / CR LF)
OF	Output the set frequency	OF (, / , / CR LF)
AT	Turn ON the ATT	AT (, / , / CR LF)
AN	Turn OFF the ATT	AN (, / , / CR LF)
UN	Change the unit of the output data to dBμV	UN (, / , / CR LF)
UF	Change the unit of the output data to dBμV/m	UF (, / , / CR LF)

(Description of remarks column)

CL (, / , / CR LF) means that another code can be entered into the location of (1). That is, a program is written as follows:

```
WRITE @105: "CL, OL, AT"
```

(a) Use of device function codes

```
line
10:     WRITE @ 105: "CF 870.2125, CL, OL, AT"
```

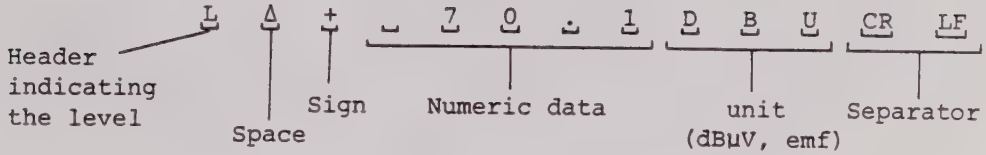
GP-IB select code — Device No. — Frequency setting (MHz) 7-digit numeric — Level CAL — Level information output — ATT ON

```
20:     READ @ 105: A$
30:     PRINT A$
```

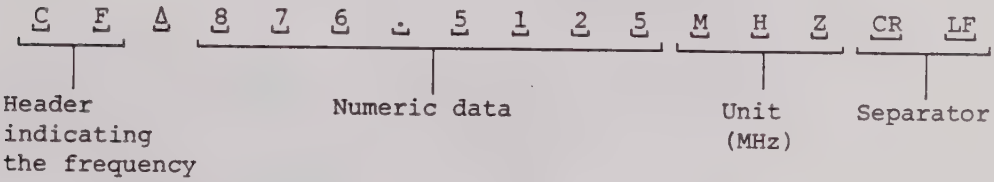
More than one function code can be entered on one line as shown in line 10. The upper limit is 80 characters. If more than two function codes are written, they are executed sequentially in the order they are written. That is, on line 10, the frequency is set to 870.2125 MHz first, CAL is operated, the measured level is output following CAL, and the ATT is turned ON in the end. However, the level is output by the READ statement in line 20. Attention should be paid when a program is created.

Output Format

<Level data format>



<Frequency data format>



Note: Four digits after the decimal point must always be input for the frequency data input.

(b) Description of device function code

Each device function code is described in detail below: The program examples are for the Packet series.

(i) "CF" --- frequency setting (CF numeric data)

Program example 1:

```
30 WRITE @105: "CF 800.0000"
```

Program example 2:

```
10 F=800.0000
20 WRITE @105 USING "C2,1F8.4":"CF",F
```

Execution result: The frequency is set to 800.000 MHz. The result is the same as if the receiving frequency were set from the numeric keys on the front panel. The result of execution of example 1 and example 2 is the same. When the frequency is set by a varaible, format specification (FORMAT statement) is necessary.

(ii) "CL" --- CAL execution request

Program example:

```
WRITE @ 105: "CL"
```

Execution result: Level calibration is performed. This is the same as if the front panel CAL switch were pressed.

(iii) "OL"

Level output request

Output format: L-25.0DB
L+75.0DBU
L+100.0DBUV/M

Program example:

```
WRITE @ 105:"OL"
READ @ 105:A$
```

Execution result: The measured level is assigned to character variable A$.

(iv) "OF"

Set frequency output request

Program example:

```
WRITE @ 105:"OF"
READ @ 105:A$
```

Execution result: The set frequency data is read and assigned to character variable A$.

Note: After an OF, OL, or other output request is performed, if the data is not read by paired READ statement as shown in the program example, these instructions are not completed. One WRITE statement is also necessary for one READ statement.

(v) "AT" --- Attenuator setting (ON) request

Program example:

```
. WRITE @ 105:"AT"
```

Execution result: This is the same as if the RF attenuator were set to 20 dB by pressing the front panel RF ATT key.

(vi) "AN" --- Attenuator setting (OFF) request

Program example:

```
WRITE @ 105:"AN"
```

Execution result: This is the same as if the RF attenuator were set to 0 dB by pressing the front panel RF ATT key.

(vii) "UF"

Sets the LEVEL unit to dBμV/m.

Program example:

```
WRITE @ 105:"UF"
```

Execution result: The level unit is set to dBμV/m. This is the same as if dBμV/m were selected as the level unit by pressing the UNITS key.

(viii) "UN"

Sets the LEVEL unit to dBμV.

Program example:

```
WRITE @ 105:"UN"
```

Execution result: The level unit is set to dBμV. This is the same as if dBμV were selected as the level unit by pressing the UNITS key.

(4) Notes on programming

On reading the level data by READ statement after specifying the frequency by WRITE statement or after commanding the execution of CAL by WRITE statement, insert WAIT time as follows: (WAIT DELAY unit is seconds)

(i) After specifying the frequency

```
10 WRITE @105 USING "C2,1F8.4":"CF",620.2050
20 WAIT DELAY 1
   WRITE @105:"OL"
30 READ @105:A$
```

(ii) After commanding the execution of CAL

```
60 WRITE @105:"CL,OL"
70 WAIT DELAY 4
80 READ @105:A$
```

(5) Notes on GP-IB operation

(i) Operation of ML521/522/524 front panel controls is disabled during GP-IB operation is executed (remote state).

(ii) During GP-IB operation is executed, if abnormal operation occurs, normal operation will be expected by applying the following procedures.

First, press RESET (SHIFT RESET in Packet series computer) for suspending the program execution.

Then execute the following command on the direct mode (input directly to the key board).

```
IFC @105
```

Or, switch off ML521/522/524 power and then switch it on again.

(iii) No switch is provided for Remote/Local mode changeover. However, applying WRITE command enables the Remote mode through GP-IB connection. To change to the Local mode, switch off ML521/522/524 power, or execute the following command on the direct mode.

```
LCL @105
```

On the Local mode, the operation of ML521/522/524 front panel controls is enabled.

(6) Program examples

Example 1 shows a program which sets frequencies from 300 MHz to 999 MHz in 50 MHz steps and obtains measured levels. Lines 60 and 70 sets frequencies. Line 80 is for CAL and for the wait time. Lines 90 and 100 read levels and assign them to character variables A$. Line 110 obtains numeric data from the data in A$ excepting L and DBU. Line 120 prints out the data above obtained.

Example 2 shows a program which obtains 100 level data at a fixed frequency of 500 MHz every 0.3 seconds.

Example 3 shows a program which prerecords 10 frequencies at DATA statement and sets these frequencies in order, and obtains their levels respectively.

Example 1

```
 10 !**** ML522 FREQ.SET ****
 20 !
 30 LCL @105
 40 DIM A$*200
 50 FOR F=300 TO 999 STEP 50
 60 FORMAT:C2,1F8.4
 70 WRITE @105 USING 60:"CF",F
 80 WRITE @105:"CL"¥WAIT DELAY 4
 90 WRITE @105:"OL"
100 READ @105:A$
110 LET A=VAL(A$(3:8))
120 PRINT A
130 NEXT F
140 END
```

Example 2

```
 10 !**** ML522 LEVEL READ ****
 20 !
 30 LCL @105
 40 DIM A$*200
 50 WRITE @105:"CF500.0000"
 60 WRITE @0:500,"MHz"
 70 WRITE @105:"CL"¥WAIT DELAY 4
 80 FOR N=0 TO 100
 90 WRITE @105:"OL"
100 READ @105:A$
110 LET A=VAL(A$(3:8))
120 WRITE @0:A,"dB"
130 WAIT DELAY .3
140 NEXT N
150 END
```

Example 3

```
 10 !**** ML522 LEVEL READ ****
 20 !
 30 LCL @105
 40 DIM A$*200
 50 FOR I=1 TO 10
 60 READ F
 70 FORMAT:C2,1F8.4
 80 WRITE @105 USING 70:"CF",F
 90 WRITE @105:"CL"¥WAIT DELAY 4
100 WRITE @105:"OL"
110 READ @105:A$
120 LET A=VAL(A$(3:8))
130 FORMAT:1F8.4,C6,1F4.1,C2
140 WRITE @0 USING 130:F,"MHz    ",A,"dB"
150 NEXT F
160 DATA 600.225,703.54,767.375,785.5
170 DATA 800,811,833.86,906.125,955.075,999.9875
180 END
```

3.4.3 Antenna factor storing

To convert the measured voltage (dBμV) to field strength (dBμV/m) and display it, the antenna factors of the measurement antenna (MP534B, MP651B, MP635A) are stored in the internal ROM (Read Only Memory) in advance. If an antenna other than these is used, the new antenna factors can be stored through the GP-IB (Option 01) to the internal RAM (Random Access Memory). Up to 100 factors can be stored.

(1) Antenna factor

Antenna factor is defined for this instrument as follows:

$$Ko = Vo - E \quad \ldots\ldots (1)$$

Ko: Antenna factor (dB)
Vo: Measured voltage (dBμV, open circuit voltage)
E : Field strength (dBμV/m)

However, the measured voltage may also be expressed by terminated voltage and defined as follows:

$$Kt = E - Vt \quad \ldots\ldots (2)$$

Kt: Antenna factor (dB)
Vt: Measured voltage (dBμV, terminated voltage)
E : Field strength (dBμV/m)

The voltage measured by the ML521/ML522/ML524 is expressed as open circuit voltage and is converted to field strength by using the antenna factor defined by Eq. (1). When the antenna factor defined by Eq. (2) is to be stored to the internal RAM, convert it to;

$$K_o = -K_t + 6 \text{ (dB)}.$$

(2) Relationship between antenna select switch and antenna used

The relationship between the setting of both S1 and S2 of the rear panel and the antenna used is shown in Table 3-11.

Table 3-11 Antenna Select Switches

S2	S1	Antenna	
0	0	MP534B, MP651B	
0	1	MP635A	
1	0	Undefined	← Part to which new antenna factors can be stored.
1	1	Unusable	

(3) Device function code

The device function codes are shown in Table 3-12.

Table 3-12 Device Function Codes

Code	Function	Remarks
ST	Data table creation request	ST(,/,/CR LF)
SP	Data table creation stop	SP(,/,/CR LF)
AF	Data input	AF(,/,/CR LF)
FN	Data output request	FN(,/,/CR LF)
FF	Data output stop	FF(,/,/CR LF)

(a) "ST" --- data table creation request

Program example:

```
WRITE @105: "ST"
```

Execution result: All the data tables in which antenna factors are stored are cleared.

(b) "SP" --- data table creation stop

Program example:

```
WRITE @105: "SP"
```

Execution result: Storing of antenna factors is stopped.

(c) "AF" --- data input

Program example:

```
WRITE @105: "AF35.2+6.4"
```

Execution result: Stores that the 35.2 MHz antenna factor is 6.4 dB in the data table.

The frequency data can be stored up to 100 kHz of the ML521/ML522/ML524 receiving frequency. Antenna factors of ±0.0 to ±99.9 (dB) can be stored. An example of a program which can be input and an example of a program that cannot be input are shown below:

Example 1: Program which can be input

```
WRITE @105:"AF111.1+11.1"
WRITE @105:"AF222+22.2"
WRITE @105:"AF33+33.3"
WRITE @105:"AF44.4+44.4"
WRITE @105:"AF555.5-55.5"
WRITE @105:"AF66.6-66.6"
WRITE @105:"AF777.7-77"
WRITE @105:"AF888.8-8"
```

Example 2: Program which cannot be input

```
WRITE @105:"AF1111+11.1"
WRITE @105:"AF222+222"
WRITE @105:"AF33+-33.3"
WRITE @105:"AF44.4++44.4"
WRITE @105:"AF555.5--55.5"
WRITE @105:"AF66.6+-66.6"
WRITE @105:"AF777.7- 77"
WRITE @105:"AF888.8 -8"
```

(d) "FN" --- data output request

Program example:

```
WRITE @105: "FN"
```

Execution result: Prepares to output data through the GP-IB.

(e) "FF" --- data output stop

Program example:

```
WRITE @105: "FF"
```

Execution result: Data output is stopped.

---

(4) Antenna factor storing

Storing of the antenna factor is performed irrespective of the setting of antenna select switches S1 and S2. Store the antenna factors sequentially from low to high frequency. The frequency of minimum 100 kHz digit can be input and antenna factors can be input from ±0.0 to ±99.9 (dB).

When the frequency lower than 100 kHz is input, it is converted by the values shown in the Input Value Conversion Table (Table 3-3) and numeric value of the 100 kHz is input.

Up to 100 factors can be stored.

Example 1 is a program which stores factors of an antenna.

Example 2 is a program which stores the data by using DATA statements.

Example 3 is a program which automatically stores the data.

Example 1

```
 10 !***ANTENNA FACTOR STORE (1) ***
 20 !
 30 WRITE @105:"ST"
 40 WRITE @105:"AF25-11.1"
 50 WRITE @105:"AF27-13.1"
 60 WRITE @105:"AF29-15.1"
 70 WRITE @105:"AF31-17.1"
 80 WRITE @105:"AF33-19.1"
 90 WRITE @105:"SP"
100 LCL @105
110 END
```

Example 2

```
 10 !***ANTENNA FACTOR STORE  (2) ***
 20 !
 30  WRITE @105:"ST"
 40  FOR N=1 TO 10
 50    READ F$,K$
 60    FORMAT:C12
 70    WRITE @105 USING 60:"AF"&F$&K$
 80  NEXT N
 90  WRITE @105:"SP"
100  DATA "25","+99.9","50","+77.7","100","+55.5","300","+33.3","500","+11.1"
110  DATA "600","-11.1","700","-33.3","800","-55.5","900","-77.7","999.9","-99
.9"
120  LCL @105
130  END
```

Example 3

```
 10 !***ANTENNA FACTOR STORE (3) ***
 20 !
 30 WRITE @105:"ST"
 40 FOR F=25 TO 300 STEP 5.5
 50 LET D=F/10
 60 FORMAT:C2,1F5.1,C1,1FZ4.1
 70 WRITE @105 USING 60:"AF",F,"+",D
 80 NEXT F
 90 WRITE @105:"SP"
100 LCL @105
110 END
```

(5) Antenna factor usage

Set the antenna select switches S1 and S2 according to the antenna used. Set the switches as follows for storing new factors:

S2	S1
1	0

(6) Antenna factor check

The antenna factors (K_o) written in the internal ROM or RAM can be read and checked through the GP-IB.

The following example is a program which checks the antenna factor of a specified frequency. The value to be read from this program is $-K_o$.

Example

```
10 !***ANTENNA FACTOR READ ***

20 DIM A$*20
25 WRITE @105:"UF"
30 WRITE @105:"FN"
40 INPUT PROMPT "FREQ.=?":F
50 WRITE @105 USING "C2,F8.4":"CF",F

56 WRITE @105:"OL"
58 WAIT DELAY .5
60 READ @105:A$
70 PRINT F,A$
80 WRITE @105:"FF"
90 LCL @105
95 GO TO 20
100 END
```

When the read frequency and the stored frequency are different, the data of the next frequency higher than the read frequency is output. (Table 3-13.)

*1 However, when the specified frequency is less than 100 kHz, frequency is input in accordance with the values shown in the Input Value Conversion Table. (Table 3-3.)

*2 Since only the 100 MHz, 10 MHz, 1 MHz and 100 kHz frequency digits are displayed, the same data is read until the value of 100 kHz digit, of the frequency specified at the time of storing, scrolls up. (Table 3-14.)

Table 3-13

Stored data

Frequency (MHz)	Antenna factor (dB)
100	-10
120	-12
140	-14

Read data

Specified frequency (MHz)	Antenna factor (dB)	
100	-10	
110	-12	← Same as 120 MHz data
120	-12	
130	-14	← Same as 140 MHz data
140	-14	

Table 3-14

Stored data

Frequency (MHz)	Antenna factor (dB)
123.4	-10
123.5	-11

Read data

Frequency (MHz)	Antenna factor (dB) when the set resolution is 12.5 kHz	Antenna factor (dB) when the set resolution is 1 kHz
123.4	-10	-10
123.4875	-10	-
123.499	-	-10
123.5	-11	-11
123.501	-	-11
123.5125	-11	-

The following data is output through the GP-IB according to the antenna select switch setting:

(a)

S2	S1
0	0

The MP534B and MP651B antenna factors already stored are output.

(b)

S2	S1
0	1

The MP635A antenna factors already stored are output.

(c)

S2	S1
1	0

The newly stored antenna factors are output.

SECTION 4

PERFORMANCE CHECKS

4.1 Introduction

This section describes the methods for testing the performance.

Checks may be performed for acceptance testing, inspections after repair, or periodic calibration.

If the instrument passes all the tests described, it is operating normally. Make the necessary adjustments in accordance with the service manual if items detected in these tests do not satisfy the specifications. If the specifications are still not met after adjustments, request service by ANRITSU or an ANRITSU representative.

4.2 The Performance Check Items and the Equipment Required for Performance Checks

The performance check items and the equipment required for performance checks are listed in Table 4-1.

Table 4-1 The Performance Check Items and the Equipment Required for Performance Checks

Check items	Test equipment required	Function	Recommended model	Reference (paragraph)
Frequency range	Signal generator	Range: 25 to 1100 MHz Output level: -30 to 110 dBμV	MG655A (Anritsu)	4.3.2
Voltage measurement	Ditto	Ditto	Ditto	4.3.3
Selectivity	Ditto	Ditto	Ditto	4.3.4
Signal to image ratio	Ditto	Ditto	Ditto	4.3.5
IF output	Signal generator	Ditto	Ditto	4.3.6
	Spectrum analyzer	Range: 25 to 1000 MHz Level: 0 to 110 dBμV	MS62 (Anritsu)	
Discriminator output	Signal generator	Same as MG655A	MG655A	4.3.7
	Oscilloscope	Range: dc to 20 MHz	VP5511A (Matsushita)	
	100 kΩ resistor 150 Ω resistor			

Table 4-1 The Performance Check Items and the Equipment Required for Performance Checks (Cont'd)

Check items	Test equipment required	Function	Recommended model	Reference (paragraph)
Record output	Signal generator	Same as MG655A	MG655A	4.3.8
	Digital multimeter	Measuring voltage range: 200 mVdc to 30 Vdc Measuring voltage accuracy: ±1%	3465B (HP)	
	100 kΩ resistor 150 Ω resistor			
GP-IB function	GP-IB controller	Provide most of GP-IB function	Packet IIe/III IIIs	4.3.9

4.3 Performance Checks

4.3.1 Preliminary operations

The measuring receiver requires no advance warm-up. Performance tests can be made immediately after the power switch is set to ON.

However, measurement must not be started until warming-up time of other test equipment required for testing the instrument has been taken into account.

The maximum measurement accuracy is achieved by minimizing changes in room temperature, ac power and voltage fluctuation and noise. Vibration, dust and humidity levels etc. should all be low.

4.3.2 Frequency range

When the input signal level to RF INPUT is set at a constant value (60 dBμV), verify approximately 60 dBμV for all frequencies covered by the ML521/ML522/ML524. In addition, verify normal operation of the numeric key, [MHz] key, [FINE] key, FINE dial and frequency display (6 digits LCD) as the frequency data input functions.

(1) Specifications

Items		Specification
Frequency range	ML521A/B	25.000 to 300.000 MHz
	ML522A/C	300.000 to 999.9875 MHz
	ML522B	300.000 to 999.999 MHz
	ML524A/C	25.000 to 999.9875 MHz
	ML524B	25.000 to 999.999 MHz
Frequency display		6 digit liquid crystal 1 kHz Minimum digit (■ displays for 500 Hz)

(2) Measuring instrument for test

Standard signal generator ---- Frequency range 25 to 1000 MHz cover (MG655A)

(3) Setup

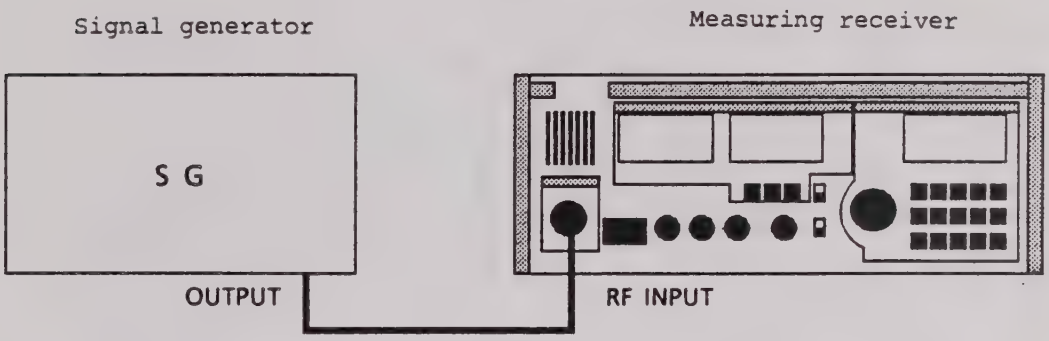


Fig. 4-1 Frequency Range Test

(4) Procedure

Step	Procedure
1	Set the signal generator output level to 60 dBμV.
2	Connect the measuring receiver RF INPUT connector and signal generator output connector as shown in Fig. 4-1.
3	Set the measuring receiver [RF ATT] key to OFF.
4	Set the signal generator output frequency and the measuring receiver receiving frequency in accordance with Table 4-2: .At this time, check that the measuring receiver indicates approximately 60 dBμV.
5	Check that the frequency display and frequency entry functions are normal at the measurement above.

Table 4-2 Frequency Range Checkpoint

No.	Frequency Setting (MHz)				
	ML521A ML524A	ML521B ML524B ML524C	ML522A ML524A	ML522B ML524B	ML522C ML524C
	Bandwidth 120kHz	Bandwidth 15kHz	Bandwidth 120kHz	Bandwidth 15kHz	Bandwidth 15kHz
1	25.0000	25.0000	300.0000	300.0000	300.0000
2	44.4500	44.4440	333.3375	333.3330	333.3330
3	59.9000	59.9990	444.4500	444.4440	444.4440
4	90.0000	75.0000	511.1125	511.1110	511.1110
5	111.1125	90.0000	555.5500	555.5550	555.5550
6	126.6625	111.1110	666.6625	666.6660	666.6660
7	155.5500	126.6660	777.7750	777.7770	777.7770
8	177.7750	155.5550	822.2250	822.2220	822.2220
9	188.8875	177.7770	888.8875	888.8880	888.8880
10	222.2250	188.8880	999.9875	999.9990	999.9990
				Bandwidth 120kHz	Bandwidth 8kHz
11	233.3375	222.2220	———	711.1125	711.1125
12	260.0000	233.3330	———	———	———
13	300.0000	260.0000	———	———	———
14	———	300.0000	———	———	———
		Bandwidth 120kHz (Only B type)			
15	———	111.1125	———	———	———

4.3.3 Voltage measurement

The voltage measurement for the minimum value test confirms that the measured carrier voltage satisfies the minimum value of the test specifications given in paragraph (1) at S/N = 6 dB.

The maximum value test confirms that a measured voltage of 100 dBμV can be measured.

The accuracy test confirms that the level display indication is within an accuracy range of ±2 dB when measured voltages exceeding the minimum value by 6 dB are applied. The generation source of the measured voltage uses the output voltage of a calibrated standard signal generator.

The accuracy test is performed by comparing this output voltage with the measured voltage.

(1) Specification

Model	Minimum value	Bandwidth in ( )	Maximum value	C/N	Accuracy
	25 to 300 MHz	300 to 999.999 MHz	25 to 999.999 MHz		
ML521A	14 dBμV (120 kHz)	-			
ML521B	5 dBμV (15 kHz)	-			
ML522A	-	14 dBμV (120 kHz)			
ML522B	-	5 dBμV (15 kHz)	100 dBμV But ML521/ML522 is at minimum frequency	≧6 dB	±2 dB
ML522C	-	2 dBμV (8 kHz)			
ML524A	14 dBμV (120 kHz)				
ML524B	5 dBμV (15 kHz)				
ML524C	5 dBμV (8 kHz)	2 dBμV (8 kHz)			

(2) Measuring instrument for test

Standard signal generator ----- MG655A

(3) Setup

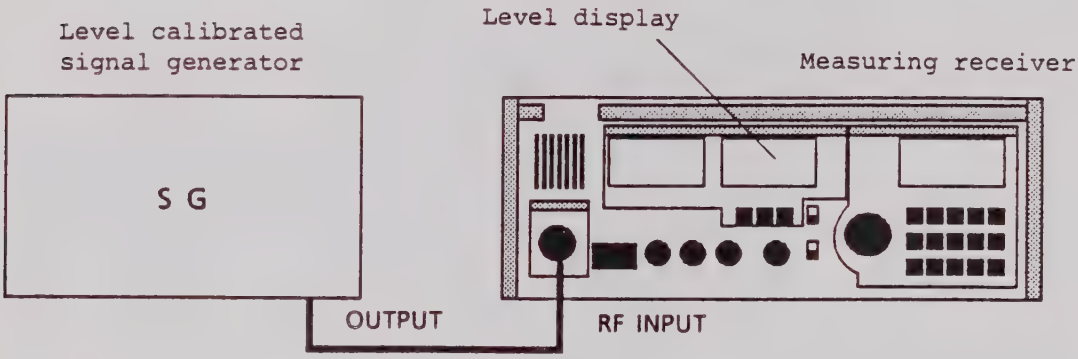


Fig. 4-2 Voltage Measurement Check

(4) Procedures

Step	Procedure
	Minimum value of the voltage measurement
1	Connect the level calibrated signal generator output to the measuring receiver RF INPUT connector as shown in Fig. 4-2.
2	Set the measuring receiver as follows: . [RF ATT] key: OFF . [UNITS] key : dBμV
3	Set the output frequency of signal generator and the receiving frequency of measuring receiver as shown in Table 4-3 using steps 4 through 15.

Table 4-3 Frequency Setting

Model		ML521A ML524A	ML521B ML524B ML524C	ML522A ML524A	ML522B ML524B	ML522C ML524C
Resolution Bandwidth		120kHz	15kHz	120kHz	15kHz	8kHz
Frequency Setting	1	25.0000			300.0000	
	2	50.0000			350.0000	
	3	75.0000			400.0000	
	4	100.0000			450.0000	
	5	125.0000			500.0000	
	6	150.0000			550.0000	
	7	175.0000			600.0000	
	8	200.0000			650.0000	
	9	225.0000			700.0000	
	10	250.0000			800.0000	
	11	275.0000			900.0000	
	12	300.0000			999.9750	

(Cont'd)

Step	Procedure
4	Set the signal generator output level to -20 dBμV or less so that the signal generator output level is set at a lower level than the noise level of measuring receiver.
5	Press the [CAL] key to execute the gain calibration.
6	Record the measuring receiver measured level digital display value as the noise level at that frequency shown in Table 4-3.
7	Set the signal generator output level 6 dB higher than the noise output level recorded.

(continued)

Step	Procedure
8	Because the signal generator output level in step 7 is the minimum input voltage of measuring receiver, check that the indication of the level display satisfies the minimum value of the specifications shown in paragraph 4.3.3 (1).
9	Change the frequency and bandwidth in accordance with Table 4-3, and repeat steps 4 to 8.
	Accuracy of the voltage measurement
10	Perform steps 1 to 3 and step 5.
11	Set the signal generator output level to a value 6 dB higher than the measuring receiver minimum value of voltage measurement specified value, and check if the displayed result on the digital display of measuring receiver is within ±2 dB at each frequency shown in Table 4-3.
	Maximum value of the voltage measurement
12	Perform step 1.
13	Set the measuring receiver as follows: [RF ATT] key: ON [UNIT] key : dBμV
14	Perform step 3 and step 5.
15	Set the signal generator output level to 100 dBμV, and check that the measured result is normal at each frequency shown in Table 4-3.

4.3.4 Selectivity

The selectivity characteristics are tested by using the single signal selectivity method.

The single signal selectivity method is used when both required and interference signals are weak, and the measuring receiver is operated in a linear area. The selectivity characteristics are measured by connecting a standard signal generator to the input terminal of the measuring receiver that receives the required signal.

The frequency must be converted into the required frequency jamming frequency, and the relative input voltage ratio of the receiver required to equalize receiver output must be used.

The selectivity characteristics of measuring receiver is measured by separately measuring the 6 dB bandwidth and detuning characteristics.

(1) Specifications

Items	Type A	Type B	Type C
6 dB bandwidth	120 kHz ±20 kHz	15 kHz ±2 kHz 120 kHz ±20 kHz	8 kHz ±1 kHz 15 kHz ±2 kHz
Rejection (Detuning characteristics)	-	≧50 dB (20 kHz detune on 15 kHz BW)	≧45 dB (12.5 kHz detune on 8 kHz BW) ≧50 dB (20 kHz detune on 15 kHz BW)

(2) Measuring instrument for test

Standard signal generator ----- MG655A

(3) . Setup

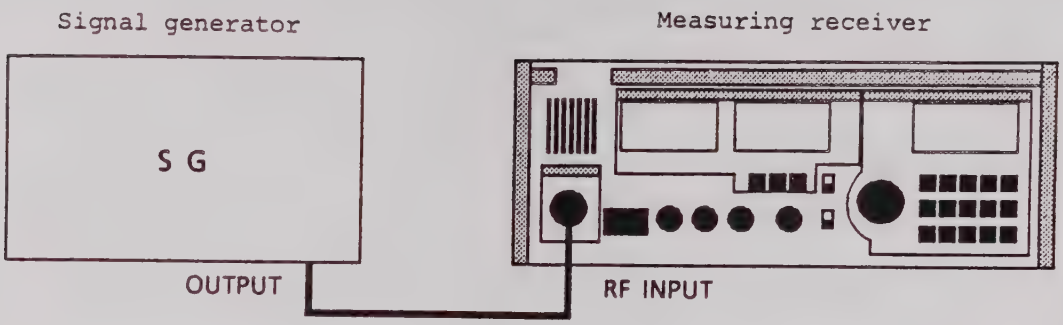


Fig. 4-3 Selectivity Check

(4) Procedures

Step	Procedure
	6 dB bandwidth
1	Connect the signal generator output to the measuring receiver RF INPUT connector as shown in Fig. 4-3.
2	Set the measuring receiver as follows: . RF ATT 20 dB: OFF . UNITS : dBµV . BW : 120 kHz
3	Set the frequencies of measuring receiver and the signal generator to 300 MHz.
4	Record the measuring receiver level display when the signal generator output level is set to 10 dBµV.
5	Increase the signal generator output level by 6 dB (20 dBµV).

(continued)

Step	Procedure
6	Set the frequency of signal generator higher than the set frequency (f_H) so that the measuring receiver shows the recorded level again as Step 4.
7	Set the frequency of signal generator lower than the set frequency (f_L) so that the measuring receiver again shows the recorded level.
8	Confirm that the value of f_H-f_L satisfies the 6 dB bandwidth specifications in paragraph 4.3.4 (1).
9	Change the bandwidth of measuring receiver in accordance with type B and type C at Step 2 and repeat Steps 3 to 8.
Rejection	
10	Perform steps 1 to 4. However, set the BW (kHz) to 8 kHz or 15 kHz in Step 2.
11	Set the signal generator frequency to 300 MHz ±12.5 kHz. (Set to ±20 kHz when the bandwidth is 15 kHz.)
12	Increase the signal generator output level 45 dB (50 dB when the bandwidth is 15 kHz) more than the set level.
13	Confirm that the measuring receiver shows less than 10 dBμV.

4.3.5 Signal to image ratio

Table 4-3 lists the signal frequencies used. Step 6 (on next page) shows the image frequencies.

The relative input voltage ratio between those levels of the signal frequency and image frequency is obtained. (The ratio is obtained to apply the image frequency so that the measuring receiver shows less than the level of signal frequency).

(1) Specifications

ML521A/B -------- ≧60 dB
ML522A/B/C ------ ≧45 dB
ML524A/B/C ------ ≧60 dB (25.000 to 299.999 MHz);
≧45 dB (300 to 999.999 MHz)

(2) Measuring instrument for test

Signal generator ----- MG655A

(3) Setup

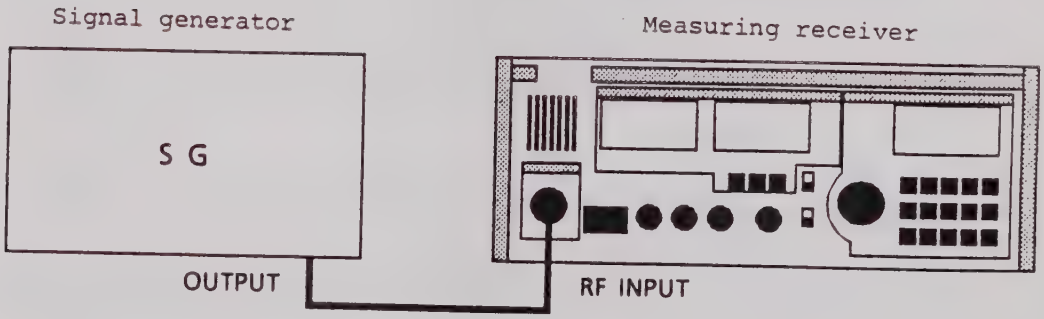


Fig. 4-4 Signal to Image Ratio

(4) Procedures

Step	Procedure
1	Connect the signal generator output to the measuring receiver RF INPUT connector as shown in Fig. 4-4.
2	Set the measuring receiver as follows: . [RF ATT] key: OFF . [UNIT] key : dBμV
3	Set the frequency of the signal generator and measuring receiver as shown in Table 4-3.
4	Press the CAL key to execute gain calibration.
5	Record the indication of level display when the signal generator output level is set to 10 dBμV.
6	Set the frequency of signal generator to the image frequency as follows:

Type	Test Frequency	Image Frequency
ML521A/B ML524A/B/C	25 to 300MHz	Receiving frequency +780.15MHz
ML522A/B/C ML524A/B/C	300 to 600MHz 600 to 1000MHz	Receiving frequency +399.5MHz Receiving frequency -399.5MHz

7	Increase the output level of signal generator 60 dB (or 45 dB, ML522 and 300 to 999.999 MHz on ML524) more than the set level.
8	Conform that the measuring receiver shows less than 10 dBμV.

4.3.6 IF output

The IF OUT signal level is measured with a spectrum analyzer when the input voltage at the RF INPUT connector is 80 dBμV.

(1) Specifications

IF OUTPUT	Level	≧85 dBμV when input level is 80 dBμV
	Impedance	50 Ω (nominal)
	Connector	BNC

(2) Measuring instruments for test

Signal generator ------ MG655A
Spectrum analyzer ----- MS62B

(3) Setup

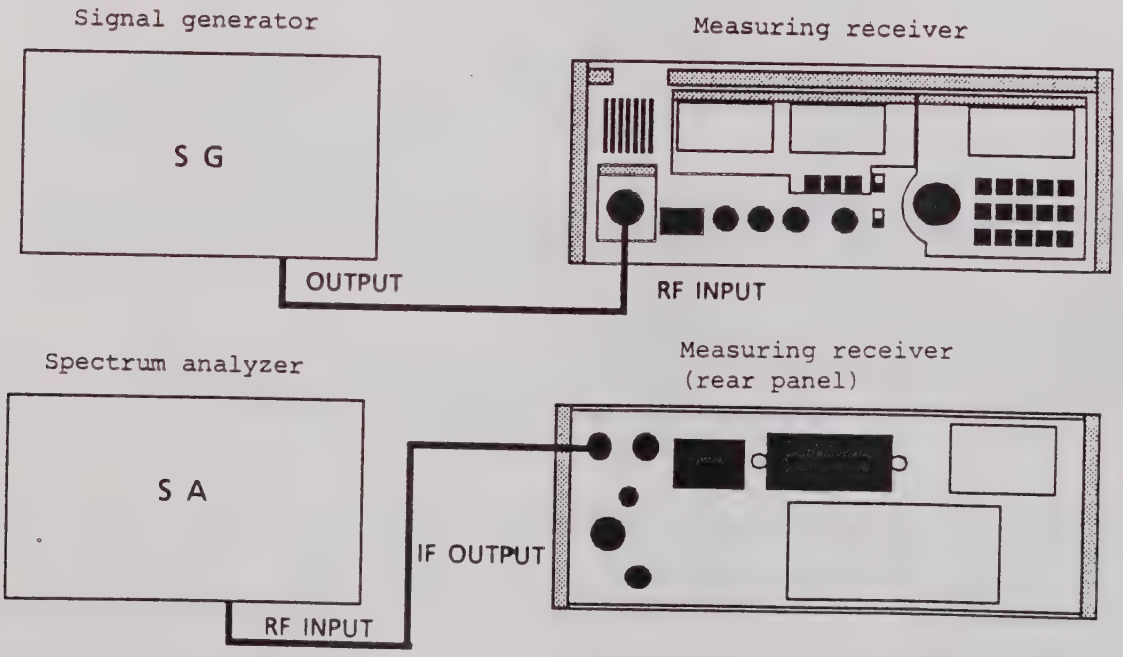


Fig. 4-5 IF Output

(4) Procedures

Step	Procedure
1	Set up as shown in Fig. 4-5.
2	Set the measuring receiver as follows: . RF ATT 20 dB: OFF . FREQUENCY : 300 MHz
3	Press the CAL switch to execute gain calibration.
4	Set the signal generator as follows: . Frequency : 300 MHz . Output level: 80 dBμV
5	Measure the IF OUT signal level with a spectrum analyzer.
6	Convert the spectrum analyzer measured value to dBμV. 0 dBm/50 Ω = 113 dBμV/emf* * emf: electromotive force

4.3.7 Discriminator output

The discriminator output must be 1 Vp-p ±20% under a 100 kΩ load when the measuring receiver receives an FM wave with a modulation frequency of 2 kHz and a frequency deviation of 3.5 kHz.

This measurement is performed by using an oscilloscope and a signal generator. In addition, the output impedance is equal to or less than 150 Ω, and is obtained from the output voltage under a 100 kΩ load and the output voltage under a 150 Ω load.

(1) Specifications

Discriminator output	Level	1 V ±20% (Modulation frequency: 2 kHz, frequency deviation 3.5 kHz, load: 100 kΩ)
	Impedance	≦150 Ω
	Connector	BNC

(2) Measuring instruments for test

Signal generator ----- MG655A

Oscilloscope --------- VP5511A (Matsushita)

(3) Setup

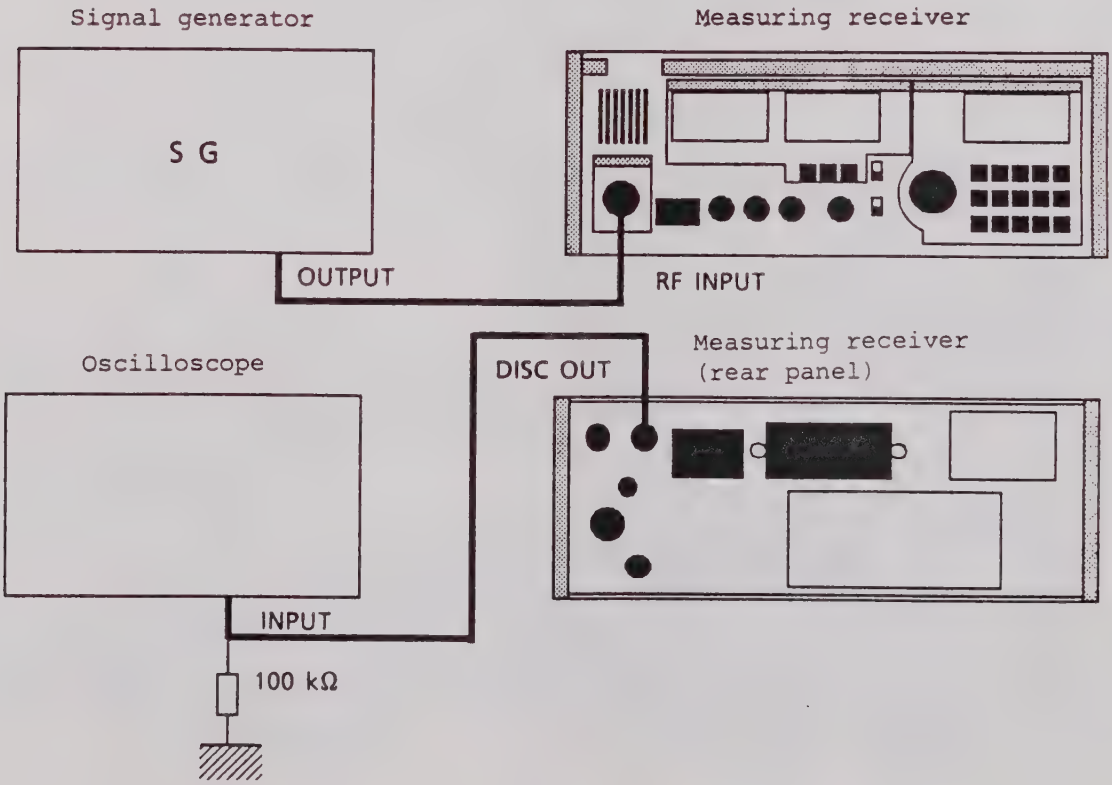


Fig. 4-6 Discriminator Output

(4) Procedures

Step	Procedure
1	Set up as shown in Fig. 4-6.
2	Set the measuring receiver as follows: . RF ATT 20 dB: OFF . FREQUENCY : 300 MHz . MONITOR : FM
3	Set the signal generator as follows: . Frequency : 300 MHz . Modulation : FM . Modulation frequency: 2 kHz . Frequency deviation : 3.5 kHz . Output level : 60 dBμV
4	Measure the peak-to-peak value of the signal on the oscilloscope CRT. Record this value as A. Confirm that the value is within the specification by calculating the peak-to-peak value as an absolute value (Volts).
5	Terminate the DISC OUT terminal by 150 Ω resistor, and measure the peak-to-peak value of the signal on the CRT. Record this value as B. The impedance of DISC OUT is calculated from the following formula: $Z = \left(\frac{A - B}{B \times 100000 - A \times 150}\right) \times 150 \times 100000\ (\Omega)$ Confirm that the calculated value is less than 150 Ω.

4.3.8 Recorder output

The recorder output from the front panel REC OUT must be 1 V ±10% under a 100 kΩ load when the 300 MHz signal of 80 dBμV is applied to the RF INPUT.

This measurement is done using a dc voltmeter and a signal generator. In addition, the output impedance is equal to or less than 150 Ω and is obtained from the output voltage under a 100 kΩ load and the output voltage under a 150 Ω load.

(1) Specification

Recorder output	Level	1 V ±10% (level display is 80 dBμV when the load is 100 kΩ)
	Impedance	≦150 Ω
	Connector	Jack 3.5 ϕ

(2) Measuring instruments for test

Signal generator ----- MG655A

Digital multimeter --- 3465B (HP)

(3) Setup

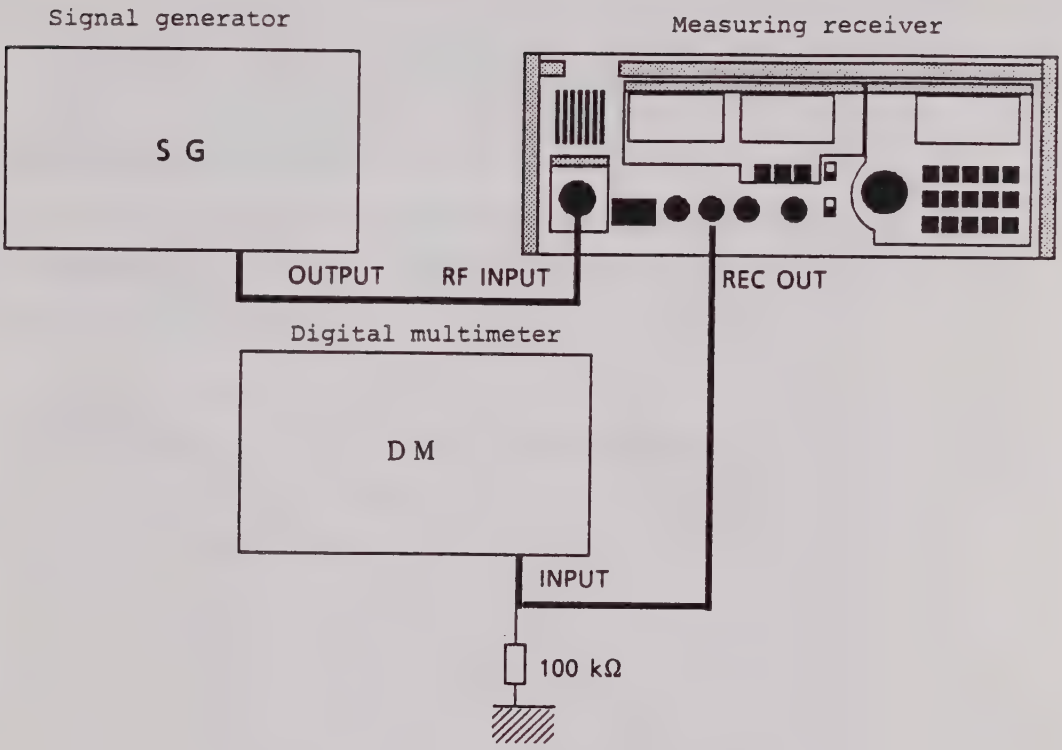


Fig. 4-7 Recorder Output

(4) Procedures

Step	Procedure
1	Set up as shown in Fig. 4-7.
2	Set the measuring receiver as follows: . [RF ATT] key: OFF . FREQUENCY : 300 MHz
3	Set the signal generator as follows: . Frequency : 300 MHz . Output level: 80 dBμV

(continued)

Step	Procedure
4	Measure the REC OUT output voltage with the multimeter. Record this value as A. Confirm that the value is within the specification.
5	Terminate the REC OUT terminal by 100 kΩ resistor, and measure the REC OUT output voltage and record this value as B. The impedance of REC OUT is calculated from the following formula: $Z = \left(\frac{A - B}{B \times 100000 - A \times 150}\right) \times 150 \times 100000\ (\Omega)$ Confirm that the calculated value is less than 150 Ω.

4.3.9 GP-IB functions

The functions of the device function codes described in the following specification and the local remote functions of the REN and LCL commands are tested by using a Packet series personal technical computer (IIe/III/IIIs) as the controller.

In addition, the measuring receiver address is set to "5" and the GP-IB interface select code is set to "1".

(1) Specification

Command	Function	Execution example
CF	Set frequency	WRITE @105: "CF300.0000"
CL	Execute CAL	WRITE @105: "CL"
OL	Output the level	WRITE @105: "OL"
OF	Output the set frequency	WRITE @105: "OF"
AT	Set ATT to ON	WRITE @105: "AT"
AN	Set ATT to OFF	WRITE @105: "AN"
UN	Set the output data unit to dBμV	WRITE @105: "UN"
UF	Set the output data unit to dBμV/m	WRITE @105: "UF"
REN	Set the remote state	REN @105
LCL	Set the local state	LCL @105

(2) Measuring instrument for test

Packet series personal technical computer

----- Packet (IIe/III/IIIs/V)

(3) Setup

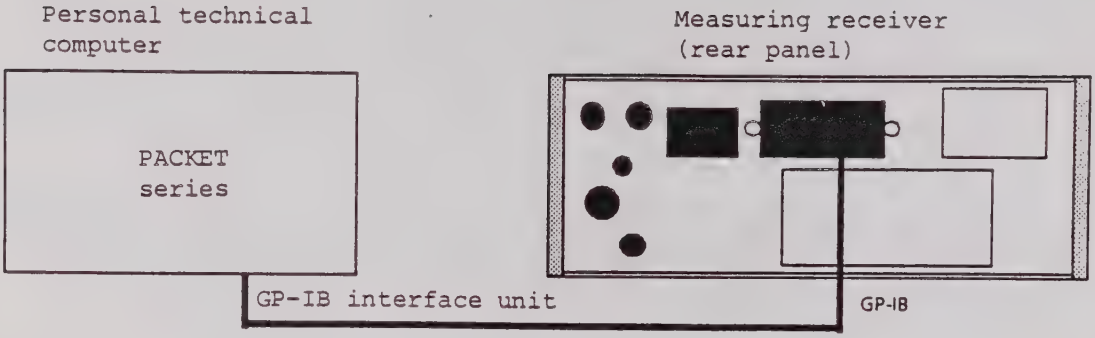


Fig. 4-8 GP-IB

(4) Procedure: Execute a program in the ACTION column and verify a result in the VERIFICATION column.

Step	ACTION	VERIFICATION
1	Execution of the frequency setting command CF:	Check that a frequency 300 MHz is set on the indication of the frequency display.
2	Execution of CAL execution command CL:	Check that calibration is executed.
3	Execution of level output request command OL: 10 DIM A$*20 20 WRITE @105: "OL" 30 READ @105: A$ 40 LET A = VAL (A$(3:8)) 50 PRINT A 60 END	Check if the measured value of the level display is indicated on the CRT of the controller

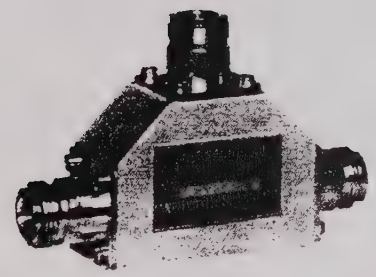
(cont'd)

Step	ACTION	VERIFICATION
4	Execution of the set frequency request command OF: 10 DIM A$*20 20 WRITE @105: "OF" 30 READ @105: A$ 40 LET A = VAL (A$(4:11)) 50 PRINT A 60 END	Check that the frequency indicated value on the frequency display is indicated on the CRT of the controller.
5	Execution of the ATT setting command AT and no setting command AN 10 WRITE @105: "AT" 20 WAIT DELAY 3 30 WRITE @105: "AN" 40 WAIT DELAY 3 50 WRITE @105: "AT" 60 END	Activation of "◀ " mark on upper left corner of the level display . Display for 3 seconds on lines 10 and 20 . No display for 3 seconds on lines 30, 40 and 50.
6	Execution of UF and UN of the output data unit setting command: 10 WRITE @105: "UF" 20 WAIT DELAY 3 30 WRITE @105: "UN" 40 WAIT DELAY 3 50 WRITE @105: "UF" 60 END	The output data unit is set to dBμV for 3 seconds with line 10 and 20. The output data unit is set to dBμV/m for 3 seconds with line 30, 40, and 50.
7	Execution of the remote setting command REN and the local setting command LCL: 10 REN @105 20 A$="Push RETURN" 30 INPUT PROMPT A$:X 40 LCL @105 50 END	Since the measuring receiver is set in the remote state with line 10, local operation of the front panel is disabled. If [RETURN] key is pressed with line 30, the measuring receiver is set to the local mode. Therefore, local operation is enabled.

APPENDIX A

OPTIONAL ACCESSORIES

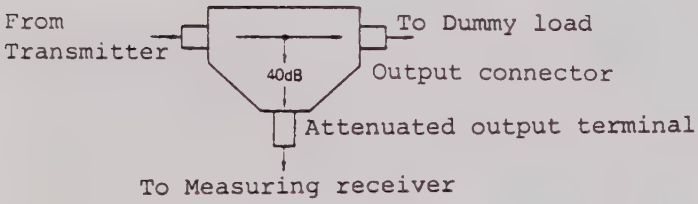
(1) Branch MP640A



MP640A

The Branch MP640A is used for branching a part of the transmitted signal in measuring the spurious characteristic of a transmitter with a measuring receiver. Its frequency characteristics of attenuation is flat over dc to 1700 MHz, so that it can be conveniently utilized for measurement without taking the frequency characteristics into consideration.

Note: The maximum allowable input power 16 W.



Specifications

Frequency range	dc to 1700MHz
Input/output connectors	Type N 50 Ω, VSWR: $\leqq$1.2
Attenuation (input terminal to attenuated terminal)	40 ±1dB at 100MHz
Attenuation characteristics	±0.5dB in the range from dc to 300MHz ±0.1dB in the range from 300 to 1000MHz ±1.5dB in the range from 1000 to 1700MHz
Insertion loss	$\leqq$0.2dB in the range from dc to 300MHz $\leqq$0.5dB in the range from 300 to 1000MHz $\leqq$1.0dB in the range from 1000 to 1700MHz

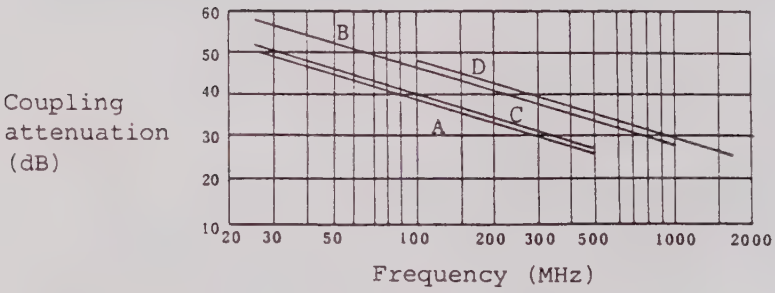
(2) CM Directional Coupler MP520A/B/C/D

For measuring the passing power and spurious power

MP520A/B/C/D

This device is employed for the measurement of fundamental frequency power and spurious power which supply coaxial feeders in VHF and UHF bands. Various models are provided in accordance with feeder impedance and frequency.

It is also capable of measuring the VSWR (voltage standing wave ratio) of antenna systems.



A,B,C and D are Type Name of MP520A/B/C/D

Coupling attenuation characteristics

An example of CM Directional Coupler Characteristics

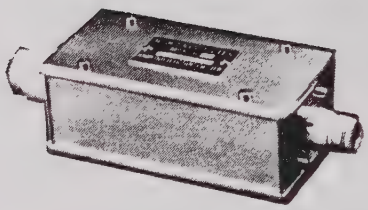
Specifications

Model		MP520A	MP520B	MP520C	MP520D
Frequency		25 to 500 MHz	25 to 1000 MHz	25 to 500 MHz	100 to 1700 MHz
Impedance	Primary line	75 Ω, connector: NC female		50 Ω, connector: N female	
	Auxiliary line	50 Ω, connector: N female			
Coupling attenuation		Approx. 38 dB at 100 MHz	Approx. 46 dB at 100 MHz	Approx. 40 dB at 100 MHz	Approx. 28 dB at 1000 MHz
Directivity		$\geqq$ 20 dB			
Terminator		50 Ω, VSWR: $\leqq$ 1.07			

Optional accessories (for MP520A/B)

Coaxial adaptor	NC-P•F-J•M-J

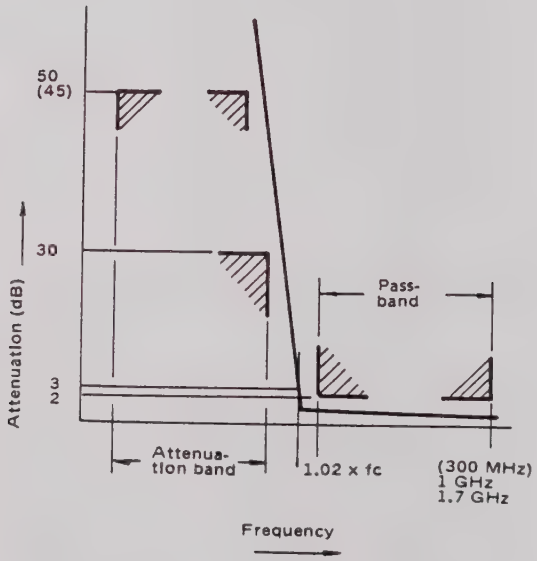
(3) High-Pass Filter MP526A/B/C/D/G



For facilitating the spurious characteristics measurement with a measuring receiver. It is recommended that eliminating the fundamental signal by using a filter in conjunction prevents the internal spurious component caused due to an excessive input on the measuring receiver.

The High-Pass Filter MP526A/B/C/D/G is directly coupled to the input connector of the measuring receiver for measuring the higher harmonics in the mobile radio frequency bands. The five types, A, B, C, D, and G, are available to suit the five different frequency bands.

External View of High-Pass Filter



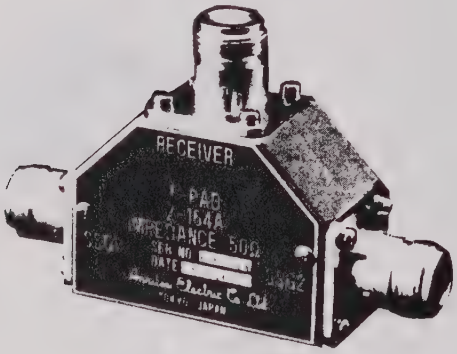
An Example of High-Pass Filter MP526A/B/C/D/G Characteristics

Specifications

Model	MP526A	MP526B	MP526C	MP526D	MP526G
Frequency band of the mobile radio to be tested	60MHz	150MHz	250MHz	400MHz	27MHz
Attenuation band	50 to 80MHz	120 to 190MHz	200 to 300MHz	335 to 520MHz	26 to 30MHz
Cut-off frequency (fc)	100MHz	240MHz	400MHz	670MHz	52MHz
Attenuation characteristics	$\geqq$50dB at 70MHz $\geqq$30dB at 80MHz	$\geqq$50dB at 170MHz $\geqq$30dB at 190MHz	$\geqq$50dB at 280MHz $\geqq$30dB at 300MHz	$\geqq$50dB at 470MHz $\geqq$30dB at 520MHz	$\geqq$45dB at 28MHz $\geqq$30dB at 30MHz
Passband	$\geqq$(1.02 x fc), $\leqq$1GHz, $\leqq$1.7GHz in MP526D, $\leqq$300MHz in MP526G				
Insertion loss	$\leqq$2dB in passband				
Characteristics impedance	50 Ω nominal, connector: type N				

(4) T-Pad Z-164A/B

A ..... connector: N-J (50 Ω)
B ..... connector: M-J (75 Ω)



T-Pad Z-164A/B

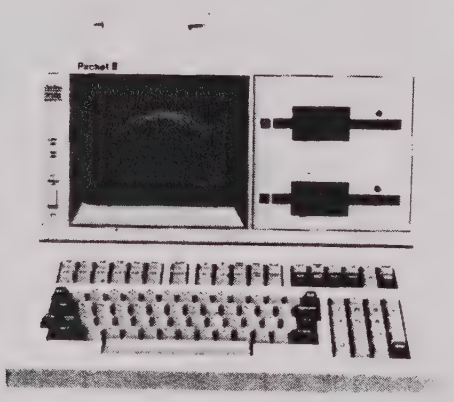
The T-Pad Z-164A/B is used to measure the two-signal characteristics of a communication receiver or that of a receiving section of mobile radio. The T-Pad Z-164A/B is used to mix two signals.

Specifications

Model	Z-164A	Z-164B
Frequency range	0 to 1000MHz	0 to 200MHz
Insertion loss	6±0.5dB (voltage ratio)	
Impedance characteristics	50 Ω VSWR: $\leqq$1.3 (up to 500MHz), $\leqq$1.5 ($\geqq$500MHz)	75 Ω VSWR: $\leqq$1.2 (up to 200MHz)
Connector	N (S)-J	M-J

APPENDIX B

PERSONAL TECHNICAL COMPUTER Packet IIe/III/IIIs



		Packet IIe (DDC7706E)	Packet III (model DDC7707A)	Packet IIIs (Main Unit: DDC7708A, CRT: DDY7791A)
CPU		68000 (8MHz clock)	68000 (8MHz clock)	68000 (8MHz clock)
Memory	ROM	16kB	16kB	16kB
	RAM	512kB (7MB/max)	512kB (7MB max)	512kB (8MB max)
Auxiliary memory devices (with file structure)	Built-in	Mini floppy-disk drive (320kB/drive)	Mini floppy-disk drive (1MB/drive)	Mini floppy-disk drive (1MB/drive)
	Built-in (option)	Bubble memory (512kB/board)	Bubble memory (512kB/board)	Bubble memory (512kB/board)
	External (option)	8" floppy-disk drive (1MB/drive x 2)	8" floppy-disk drive (1MB/drive x 2)	8" floppy-disk drive (1MB/drive x 2)
	External (option)	20MB hard-disk drive (14 units max)	20MB hard-disk drive (14 units max)	20MB hard-disk drive (14 units max)
Display	Type	Internal 9.5" amber CRT	Internal 9.5" amber CRT	Separate 12" amber CRT
	Characters	6 x 8 dot matrix, 29 lines of 64 characters (three-screen scroll buffer)	6 x 8 dot matrix, 29 lines of 64 characters (three-screen scroll buffer)	6 x 8 dot matrix, 29 lines of 64 characters (three-screen scroll buffer)
	Graphics	512 x 348 dots, independent 4-screen buffer	512 x 348 dots, independent 4-screen buffer	512 x 348 dots, independent 4-screen buffer

(cont.)

		Packet IIe (DDC7706E)	Packet III (model DDC7707A)	Packet IIIs (Main Unit: DDC7708A, CRT: DDY7791A)
Clock/ timer/ counter	Realtime clock	Year, month, date, day, hour, minute, second, 1s resolution (with battery backup)	Year, month, date, day, hour, minute, second, 1s resolution (with battery backup)	Year, month, date, day, hour, minute, second, 1s resolution (with battery backup)
	Wait timers	Eight timers, 1ms resolution	Eight timers, 1ms resolution	Eight timers, 1ms resolution
	Pacers	Four pacers, 1ms resolution	Four pacers, 1ms resolution	Four pacers, 1ms resolution
	Counter	One counter, 1ms resolution (count: 0 to 65535)	One counter, 1ms resolution (count: 0 to 65535)	One counter, 1ms resolution (count: 0 to 65535)
Tone generator		Frequency (200Hz to 15kHz), variable length	Frequency (200Hz to 15kHz), variable length	Frequency (200Hz to 15kHz), variable length
Keyboard		Full ASCII character set, ten-key pad, 12 function keys, editing keys, command keys	Full ASCII character set, ten-key pad, 12 function keys, editing keys, command keys	Full ASCII character set, ten-key pad, 12 function keys, editing keys, command keys
Expansion slots		7 slots (Anritsu bus specification)	7 slots (Anritsu bus specification)	10 slots (Anritsu bus specification)
DMA capability		Standard	Standard	Standard
Ambient temperature/ humidity, rated range of use		5 to 45°C, 20 to 80% RH (no condensation)	5 to 45°C, 20 to 80% RH (no condensation)	5 to 45°C, 20 to 80% RH (no condensation)
Power		100V, 50/60Hz, ≦200VA (basic unit)	100/220VAC, 50/60Hz, 200VA	100/220VAC, 50/60Hz, 200VA

(cont.)

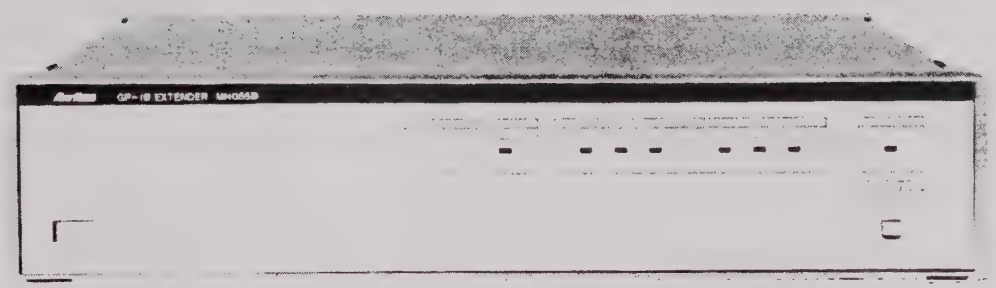
	Packet IIe (DDC7706E)	Packet III (model DDC7707A)	Packet IIIs (Main Unit: DDC7708A, CRT: DDY7791A)
Dimensions	280H, 436W, 650D (with full keyboard), ≤28kg (basic unit)	280H, 436W, 650D	Main unit: 280H, 436W, 456D CRT : 364H, 362W, 342D Keyboard : 59H, 430W, 230D
Options	Option 01: Simplified keyboard; Option 02: Mini floppy-disk drive; Option 03: Built-in thermal printer		

Extended BASIC specifications

Effective digits	Decimal, 12 digits
Dynamic range	$-9.99999999999 \times 10^{99}$ to -1×10^{-99}, 0, 1×10^{-99} to $9.99999999999 \times 10^{99}$
Types of numerical variables	Double precision, single precision, integer precision
Operators	+ - * / ↑ = < > & AND OR NOT XOR
Array dimensions	Up to three dimensions
Character string data length	255 characters
Characters handled	Alphanumeric letters (capitals and small letters), symbols, numbers, Greek letters
Name of variables	Numerical variables: Alphanumeric letters beginning with A to Z Character string variables : Alphanumeric letters beginning with A to Z with a "$" added to the end. Any desired number of characters
Statements	177 ANS standard BASIC statement Input/output statement GP-IB control statement Parallel processing statement Exceptional processing statement Graphics statement Matrix statement Other statement
Command	31
Numeric supplied functions	37
Binary operation functions	11
Character string functions	20
Other functions	22

APPENDIX C

GP-IB EXTENDER (MH055B)



Items	Specification
Transmission of GP-IB interface	Transmit the GP-IB status to the facing extender.
Serial interface	. Modem interface (JIS C 6361, RS232C) . Current loop interface (20 mA) . Internal modem (optional)
Communication mode	Full-duplex with start-stop synchronization
Baud rate	110, 300, 600, 1200, 4800, 9600 bit/s
Character composition	. Start bit 1 bit . Data bit 8 bits . Parity bit odd/even/none . Stop bit 1 bit/2 bit
Serial interface connector	BP-25p

APPENDIX D

USING THE RECORDER OUTPUT

This measuring instrument is provided with a recorder output terminal to record measured results. This terminal is usually connected to an analog recorder but can also be connected to the A/D converter of a personal computer.

1. Measuring Receiver I/O Characteristics

This recorder output terminal outputs the same signal as the level meter display signal.

Relationship between the recorder output level and RF input level is as follows:

RF input level (dB μV)	Recorder output level (V)
0	0
20	0.25
40	0.5
60	0.75
80	1.0

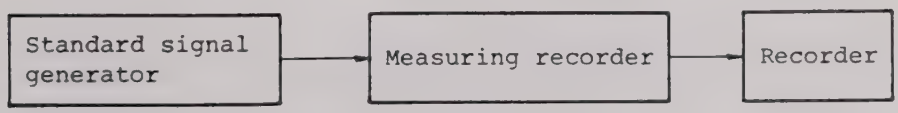
Note 1:

Use a recorder with high input impedance (100 kΩ or more).

Note 2:

The above data examples show approximate values.
To obtain accurate values, measure recorder output levels using a signal generator.

0, 10, 20, 30, 40, 50, 60, 70, 80 dB μV



Change the level in 5-dB or 10-dB units and record the measured values on recording paper.

The I/O characteristics are not affected by measuring frequencies except at lower input levels (0 to 5 dB), which are affected by noise.

2. Generation of Switching Noise

This instrument can measure an 80-dB range without any switching operation by using an attenuator. This range is achieved by the automatic switching operation to switch levels according to input level magnitude. Levels are switched at 20, 40, and 60 dB. However, when measuring a range which exceeds one or more of these switching points, note that switching noise is generated at these switching points. Fig. 1 shows the noise values.

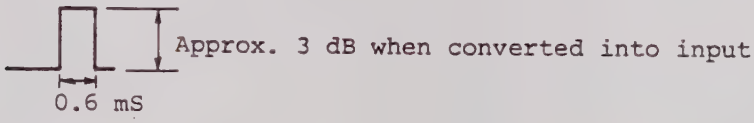


Fig. 1 Switching Noise Generated at 20, 40, and 60 dB

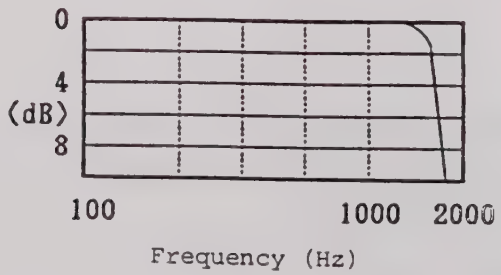


Fig. 2 LPF Insertion Loss Frequency Characteristics

3. Recorder Output Frequency Characteristics

This measuring instrument contains a low-pass filter in the recorder output circuit with a cut-off frequency of 1.6 kHz. Fig. 2 shows frequency characteristics of this low-pass filter.

APPENDIX E

SIGNAL RESPONSE FOR GP-IB OUTPUT

There are two methods for recording the measurement results: one is direct output to an analog recorder, the other is via the GP-IB interface to a personal computer.

The passband width generally determines the upper bound of the receiver demodulation signal frequencies. However, the upper bound is determined by the cut-off frequency (1.6 kHz) of the built-in low-pass filter for recorder output of this measuring instrument. When the GP-IB is used, the upper bound depends on the A/D converter. Characteristics are shown in Fig. 1.

Therefore, the recorder output is more suitable than the GP-IB output for measuring a signal that frequently changes. To use the recorder output, data can be transferred from the recorder to the personal computer connected as shown in Fig. 2 (See "USING THE RECORDER OUTPUT").

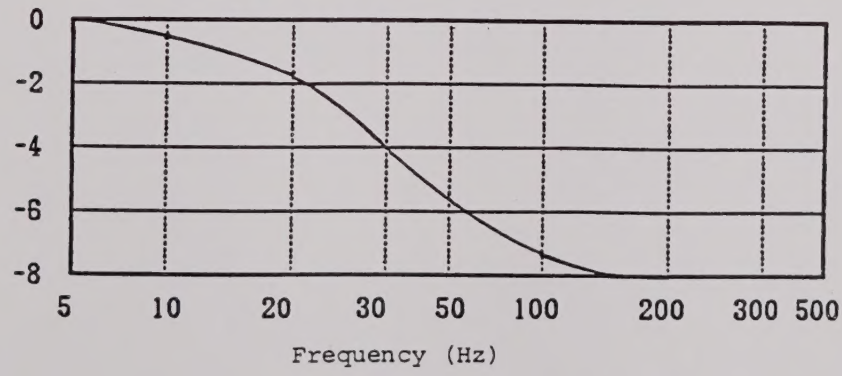


Fig. 1 GP-IB Output Frequency Characteristics

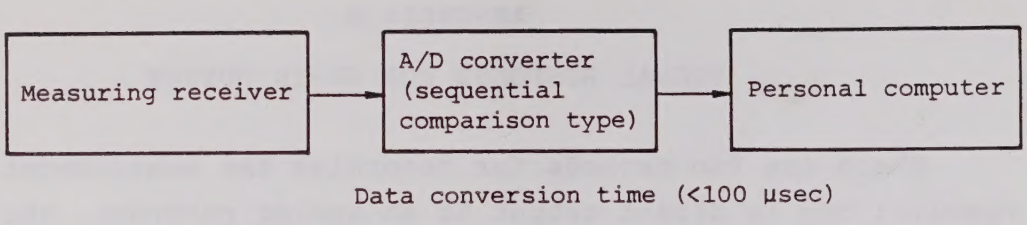


Fig. 2 Transferring Data from the Recorder to the Personal Computer

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